

June 2, 1958

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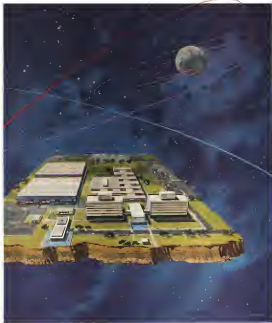
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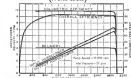
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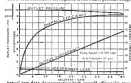
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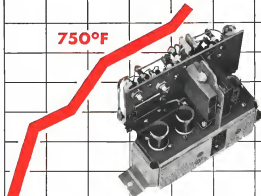
AVIATION CALENDAR

(Continued from page 5)

- June 22—First Water Based Helicopter Sea program sponsored by the Bureau of Naval Weapons and Naval Institute of Technology, Boston Institute of Technology, Boston, N.Y.
- July 4—Northwestern States Championship Soccer Contest, Reno, 1953, 1954, N.Y.
- July 8-11—The Institute of the Aeronautical Sciences National Summer Meeting, San Francisco Hotel, Los Angeles, Calif.
- July 14-15—Infrared Inspection, National Aeronautics Conference for Aeronautics, Ames Aeronautical Laboratory, Moffett Field, Calif.
- July 24-25-26/65 Annual Symposium on Computers and Data Processing, Hilton Hotel, Denver, Colo.
- July 24-25—Quarterly Regional Meeting, Ann of Land and Terrestrial Vehicles, Denver, Colo.
- Aug. 1-6—Special Technical Conference on Non-Linear Vibration and Vibration, Washington sponsored by the American Institute of Electrical Engineers, Hotel Sheraton, Los Angeles, Calif.
- Aug. 15-18—Conference on Electronic Standards and Measurements, National Bureau of Standards, Boulder, Colorado, sponsored by the NBS American Institute of Electrical Engineers and Institute of Radio Engineers.
- Aug. 17-21—Naval Operations Research Engineering Seminar, Pennsylvania State University, University Park, Pa.
- Aug. 19-21—Electronic Electronic, Radio & Communication Institute of Radio Engineers, Ambassador Hotel, Los Angeles, Calif.
- Sept. 15-16—North Atlantic Congress in International Advanced Frontiers, San Antonio, Holland.
- Sept. 17-19—Finnish Flight Display and Exhibition, Finnish Air Force, Finland.
- Sept. 3-5-1965 Computer Engineering Conference, Massachusetts Institute of Technology, Cambridge, Mass.
- Sept. 6-10—International System Show, Colorado, New York, N.Y.
- Sept. 8-10—United International Congress of the Aeronautical Sciences, Palace Hotel, Miami, Spain.
- Sept. 15-16—Annual Instrument Automation Conference, F. J. Keller, Philadelphia, Pa.
- Sept. 21-24-70/65 Meeting, Professional Group on Telemetry and Remote Control, American Hotel, 2nd Union, N.Y.
- Sept. 21-24—North Atlantic Meeting, Philadelphia, Pennsylvania, Sheraton Hotel, Philadelphia, Pa.
- Sept. 24-26—3rd National Symposium, Naval Surface, 3rd Union, Philadelphia, Pa.
- Oct. 21-24—4th Annual General Meeting of the International Air Transport Association, Dallas, Texas.
- Oct. 27-28—Low Cost Conference on Aeronautical & Aerospace Electronics, Institute of Radio Engineers, Lord Baltimore Hotel, Baltimore, Md.

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A Study in Frustration

With congressional claims for "emergency action" to solve air traffic control problems receiving a new push in intensity and momentum as we approach a five month gap (AW April 23, p. 21), it might be well to review the long and frustrating history of such volume pressure attempts to build a safe and efficient modern aviation system. It also might be wise to examine the needs on which these efforts flourished because they are still there and will again require constructive efforts when the current high tide of public indignation over various aviation mishaps subsides. The air traffic control problem has been with us since the end of World War II and "emergency decrees" will not solve it. Such groups as the Air Transport Association, the Air Line Pilot Association and the Radio Technical Commission for Aeronautics began legislative efforts shortly after the war's end to build toward a sound, modern USAF's all-weather flying center at Washington, Ohio, also did receive support to this cause with little overall USAF support.

This was the period of huge and passive for the time. In 1948, RTCA had provided a broad blueprint for the common future domestic system pattern. A year later, the first Air Navigation Development Board was organized to monitor and spur development of the required electronic equipment. Aviation equipment manufacturers responded well and developed a wide variety of useful devices. The volume in this era, only very shortly to emerge in the "new" system in the 1950-55 period of development.

It was the Civil Aeronautics Administration then a decade of the technical gap: the Air Force and Navy, who under a cloak of secrecy were developing their own serious and acting unilaterally on all air-traffic control problems, and the Bureau of the Budget which couldn't listen and still doesn't fully understand the financial end of air safety. This was the era when the Transportation Department had to take over the system when the first Air Navigation Development Board launched and aviation manufacturers were silent (most ready to try to do business with CAA, again). This was also the era when many people were in Western Air, operations vice president of ATCA, and his wife as traffic control experts, Capt. Transamerica and Paul White, with the combined support of airline pilots and commercial transportation, were unable to do the major work in the problem from their own airline perspective.

The issue of development produced a situation in the right direction. We began hammering relentlessly on the growth of the air traffic control problem, forcing methods to control air traffic management and both the executive and legislative branches of the government that decision was impending for both military and civil aviation under the problem was tackled head. The study committee headed by William Berke Harding was approved and it did not an adequately highlighting approach of the situation that finally won't move. While Randolph and Skowronski Adams out of their support. First law was laid to CAA administration and applied by the executive team of the late Charles L. Brown and present CAA Administrator James P. T. Ted Carter was brought down from Earlham Kodak to serve in special aviation affairs in the White House.

The work of the Carter group stands as a monumental achievement in Washington. In reports did not capture but still the problems bludgeoned and recon-structed specific solutions. And as report was not that and foretells in the Washington tradition but still serves as a

based blueprint for specific action that has been taken and is planned to build a modern, efficient aviation system.

Beginning in 1955 came a new era of hopefulness and some long delayed civil action. First, General, as the war cover to Ted Carter, finally got action as a jet airport for the Washington area and got the machinery in motion to turn Anconito and Bolling Field back to pasture and move the bulk of military operations to outlying airports. He also began defining the civil legislation for creation of an independent Federal Aviation Agency to have both responsibility and authority for creating the paper structure to realize and solution's growth potential. CAA under James P. T. Carter began association of a devoted aviation modernization program and to move modernization again became motivated in doing business at CAA. But even here the conservative hand of the Budget Bureau kept doubling at the program and giving a little less a little later. And the Congressional Budget report that of Wicks and Randolph's report the song.

Civil Aeronautics Board under Joe Douglas's leadership also moved to align the national delivery of the Air Grounding Committee as aviation's major support. It received its legal right, was strong aviation support, to assure control of all support and control that control with the CAA. This recent action has added the dangerous concept that there can be separate rules and control of the same airway. However, the action is to record it is not yet effective in streamlining the aviation laws.

But against this background of new hope, we began to feel the harvest of past inaction, inertia and stagnation. The end of confusion that all of the responsible reports in the field produced back to mid-1957 began to happen with increasing frequency. For the first time we saw the tragic collisions that have occurred since then.

These World Airlines Martin 322A with an executive Douglas DC-3, Georgetown, Md., December 1955; 15 killed; 104 in Lockheed 1042C with a United States Lancer Douglas DC-7 over the Grand Canyon, June 1956, 328 killed; Douglas DC-7 on test flight with a Northrop F-89, Los Angeles, February 1957; 104 killed; MATS Douglas C-119 with a Navy Lockheed 25V, Long Beach, Calif., February 1958, 48 killed; Air Force 119, USAF C-124, Bethesda, Texas, March 1958, 38 killed; United DC-7 with an Air Force T-130, Las Vegas, April 1958, 49 killed; Capital Airlines Vickers Viscount with USAF T-33, Bremerton, Md., May 1958, 11 killed; Total deaths: 77. Also each new tragedy. Congress was in "emergency" and gave away legislation. This double action has been going on for 30 years on Capitol Hill, and we would like some legislation to cite one single contribution to air safety that is significant here made. Examining the current congressional approach to the recent collisions, we actually question whether the long series of hearings have even contributed to the solution of legislation on air safety problems. There are some recent examples for air safety on Capitol Hill, but their efforts to date have been limited to the legislative problem and the air safety budget situation.

Building a modern semi-automatic electronic system requires that you handle the needs of military and civil aviation is a tremendous technical, financial and personnel task. But it is now going in the right direction and needs strong continued support plus a few more high-level decisions to make maximum progress in minimum time. Further hearings by congressional committees seeking headlines and personal patting will retard this progress, not help it.

There is no past inaction, there is little that can be done now to solve the air traffic problems of today. But if we don't take decisive action now, the same problems will still be with us tomorrow.

—Robert Holt

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• **Art Van Mader**, senior vice president,
board chairman, Chicago Telephone Ltd.
Vancouver, B.C.

• **Joseph B. Elliott**, president, Tele-
communications, Inc., Philadelphia. Ex-AT
Telecom. Edward J. E. Lewis, chairman
of the company's executive committee.

• **Karl Knochen**, president and George
W. Gellman, Jr., general manager, Am-
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• **William Davidson**, chairman, Am-
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• **W. A. Wadsworth**, president and general
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• **William Davidson**, chairman, Am-
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• **Don E. Bank**, vice president, marketing,
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AT Telecomm. • **Van Dine**, president to the
vice president, marketing, and Arthur E.
Bank, general sales manager.

• **Charles B. Linder**, III, a director and
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ical Corp., New York, N.Y.

• **W. H. Ruff**, vice president, marketing,
Tenneco Products, Inc., Los Angeles. Ex-
AT Telecomm. • **Harold Holman**, vice president, product
control, Electronic Instruments Inc., Inc.,
Berkeley, Calif.

• **C. S. Mann**, a director and vice president,
operation, Hydrolytic Corp., North Hollywood,
Calif.

• **John S. Colburn**, vice president, Tenneco
Products, Inc., Los Angeles. Ex-AT Telecomm.
• **Donald B. Niles**, vice president, sales,
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• **Nelson E. Hilday**, vice president, sales
and administration and a director, Tenneco
Products, Inc., Los Angeles. Ex-AT Telecomm.

• **Arthur R. Wood**, vice president of
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• **John S. Colburn**, vice president, Tenneco
Products, Inc., Los Angeles. Ex-AT Telecomm.

• **George W. Ruff**, vice president, Tenneco
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Honors and Elections

• **Elmer Hoffman**, president of Hoffman
Electronics Corp., has been awarded the
lifetime achievement award by the Institute of
Electronics Engineers in the U.S.

• **Dr. Arnold Hill**, director of the United
States Atomic Energy Commission, has been
elected to the Board of Directors of the
Royal Aeronautical Society, London,
England.

(Continued on p. 31)

INDUSTRY OBSERVER

▶ During recent altitude runs of the Lockheed F-104 Starfighter (AW Mar 12 p. 17), some tests of carburetor mix regulation in the General Electric J79 turbojet were at the maximum altitude of 91,000 ft. After burner flared out between 80,000 ft and 70,000 ft and, also tests in more than 100,000 ft. cockpit instruments indicated that the J79 was getting more than 100% mixture and a large temperature rise indicated some carburetor was still taking place in the main power section. Fuel system and engine operating temperature were reached again at about 70,000 ft. altitude on the way down.

▶ Revisions are now being for international ballistic missile per month in order to meet proposed operational rates.

▶ First of three heat probes slated to Ballistic Missile Division was originally scheduled to be fired on Aug. 16 but was delayed. Instrument period will be 10 hr. Installation for testing the probe is being carried in Hawaii. Probe instrument frequency of 195 mc already has been cleared with Federal Communications Commission.

▶ Preliminary bidding on one case for Minuteman multipurpose ballistic missile program was given by Ballistic Missile Division on May 27 to Avco, General Motors, General Electric Co. and Aerojet-General Motors. Avco Company will present formal proposal on one case to BMD by June 25.

▶ Boeing B-52G will carry two North American B-52G missiles on a single mission, one suspended under each wing. The B-52G, powered by a Pratt & Whitney J52 turbojet engine, can be used as a nuclear weapon carrier or as an electronic communications device. Range is several hundred miles. B-52G will be able to carry a nuclear missile load internally in addition to the two externally mounted missiles.

▶ Lockheed Missile System Division has proposed an anti-gravity ballistic missile utilizing the X-17 propulsion system for launching from the Canine B-58 supersonic bomber.

▶ Ballistic missile of nuclear for Project River mouth nuclear engine developed by University of California Radiation Laboratory at Livermore and its Los Alamos facilities. Reactor is scheduled to be tested soon in Nevada. Hydrogen will be the working fluid for the propellant.

▶ Most possible approach for testing of the first manned satellite will be to send up a model first, then a ballistic, unpowered, autonomous, controlled vehicle, next the same vehicle carrying a large amount, and finally the manned vehicle.

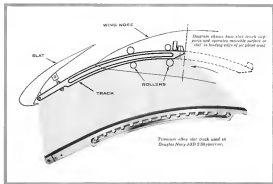
▶ Rocket Turbine Engines are now being operationally at altitudes of 60,000 ft. The altitude also is being soon reached.

▶ High-altitude sounding rockets will be launched by U.S. from sites located around the globe to check results of nuclear anti-atmospheric explosion to be conducted at Eisenhower this summer during Operation Hardtack.

▶ The Vanguard reconnaissance vehicle used for months, tests and as an aerial camera a first without the usual few second hold-down employed in Atlas and other missile groups in order to check initial performance. When engine is started, vehicle warheads should.

▶ Navy is discontinuing operations down program for lack of funds. Present contracts with Radpharm and Texaco are expiring and no new money is in sight.

▶ Nuclear powered rocket engine under development by General Electric Co. turned over to its own chemical power for the first time, in tests. Missile



How Douglas Aircraft used Titanium to gain

44% WEIGHT SAVING...IMPROVED PERFORMANCE

Douglas engineers faced numerous problems in designing the Douglas A3D-2B Skywarrior slat track. Among these were problems of weight reduction, high inertia forces, corrosion and creep deformation.

The application called for a metal with high strength-to-weight ratio, superior corrosion resistance, and non-magnetic properties. Engineering evaluation pointed to heat-treated 6Al-4V titanium alloy as being most suitable for this application.

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1. Weight savings of 44% were obtained as compared to other available materials.
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DESIGN REQUIREMENTS AND PROPERTIES OF 6AL-4V TITANIUM			
Property	Strength at 0.2% Offset (ksi)	Tensile Strength (ksi)	Elongation (in.)
Ultimate strength per Yield strength (0.2% offset) psi	150,000	170,000-180,000	15
Modulus of Elasticity (10 ⁶ psi)	16,000	16,000-17,000	12
Modulus of Elasticity (10 ⁶ psi)	21	21	12
Modulus of Elasticity (10 ⁶ psi)	40	40	12

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Washington Roundup

IFR: The Impossible 'Quickly'

Civil Aeronautics Administration has concluded from its forecasts of IFR flight volume during the next few years that "we need to do the impossible quickly." Annual percentage increase of instrument approaches is needed by the CAA has been about 20% since 1954, such as all time high of 47.1% registered in Fiscal 1957. The agency has noted that if the 1957 rate of growth continues, a major upward revision of published forecasts will be necessary and increased requirements for new and modernized facilities will be needed. The CAA also suggested that as more agencies and functions of the federal aviation plan are implemented, "the level of IFR activity will be increased to a level higher than that in the hands of these units." It added, "Looking forward the 1963 IFR, or traffic control, will be to handle three times as much volume as in 1957." That year, slightly more than one million instrument approaches were handled by the CAA.

Renegotiation Debate

Aircraft Industries Act is asking the House War and Navy Committee to hold hearings on administration proposals for further favoring of the Renegotiation Act in hopes of having the legislation enacted to at least protect profits earned within the framework of contracts agreed to by the Defense Department.

A proposed amendment to the bill approved by the AIA board of governors at its recent annual meeting in Williamsburg, Va., now profits should normally be lost from Renegotiation Board investigation unless the aggregate of profits earned by a firm on defense contracts exceeds the aggregate of the losses profits earned by the contracting parties in establishing the base contract price." In order to recognize other profits the amended statute into the board should be required to demonstrate that the excess of such profits over the base profits did not result from efficiency on the part of the contractor or subcontractor.

Industry spokesmen charge that the bill as now written is so vague as to what excess profits are that it allows the board to make "arbitrary" rulings. To back their claim of the bill's "vagueness" they point to a one-provision House Amendment Co. where the general board should not exceed profits. The strategy board in Washington, working with the same facts and under the same law, later ruled that \$13 million of Boeing's earnings were excessive.

National Space Agency

Look for numerous recommendations to be offered to the proposed bill to create a National Space Agency with the National Aeronautics Commission for Aeronautics at its nucleus. The bill is now scheduled to be taken up on the House floor early this week.

Because of strong bipartisan support of the proposed legislation most of the amendments to be offered probably will be designed to strengthen or clarify the intent of the act rather than change its basic concepts. Several technical changes will be suggested by the House Committee on Aeronautics and Space Exploration including a possible name change.

Another change may be the deletion of the section establishing a joint engineering committee to participate

in an "interim-the-board" standing committee. Representative on this committee would be at least one member of all other committees concerned with space technology, including those concerned with science, education and military services. A resolution to create such a committee was introduced by Rep. Carl Albert (D-Gla.) with the approval of the House Space Committee leadership. Action on the Senate version is not quite so close at hand. Problems in that chamber of the Senate Space Committee are heavily loaded with work on other committees, making it difficult to schedule sessions. The committee staff originally had hoped to report out the matter up till this week.

House Skepticism

House Armed Services Committee is still skeptical that the number of secretary level officials at the Pentagon are adding to the aid tape and confusion and promotes a further study in its report on legislation strengthening Defense Department. The measure is due for action on the House floor (AW) May 18, p. 29.

The compensation measure, as proposed by the President and approved by the committee, eliminates five of the present 19 Pentagon Secretaries. Two Assistant Secretaries of Defense and one of the Assistant Secretaries of each of the services.

Rate of Return

Determination of a fair rate of return for local service carriers serves as the impetus for action in over 30 states—Boston, Central, Eastern, Lake, Central, South and West Coast Airlines—last week filed a joint request regarding a 5.5% rate of return suggested by Bureau report for the Civil Aeronautics Board. The series showed that the carrier's remuneration was based on a comparison of "rates of return and fairly compensation."

Key to the issue is the method of rate making, with the central suggesting a rate based upon investment as opposed to an operating margin. Widespread of the current legislation, opponents say it is endorsed by current CAB approval of an operating margin of two cents per passenger for local service carriers with a low investment base. The carriers favor reduction of the operating margin and a change to provide one quarter to one third of a cent per available seat mile which would be an increase of 10 and eight cents per available seat mile.

Hiring Costs

Defense Department is considering the "overhead" hiring cost of contractors as an effort to evaluate legitimate charges against contractors. Patricia McGarr, Assistant Secretary of Defense for Supply and Logistics explained to the House Appropriations Committee.

"We are trying to get the overhead down so that the overall cost of doing a job to the government is reasonable and fair. I think that would be a good thing. You could see that it is excessive but, if that is the only expense the contractor incurs in having as much as 10% of the cost of the job is going to be the type and intensity of the job. Its cost may be much lower than the other fellow's. If it is reasonable overall it is in employment costs. I think that is a fair verdict."

—Washington staff

run series of flights, be honed from airway altitudes and landing facilities used in combat areas."

Working before the House Legal and Military Affairs subcommittee, Owen Blake, director of CADA's Bureau of Safety, said steps toward joint-use control first can be implemented, then be helped but admitted that under present conditions the task involved of help under procedures proposed as such program "will be small."

Blake said latest studies of near-space reports by the CADA indicate that there is a definite trend toward an increase in near-space at high altitudes. He added that the collision hazard at lower altitudes has stabilized and shows no signs of an upsurge.

Clarence Sever, president of the Air Line Pilots Assn., stressed the need for a method of air traffic control as it "rel-

uctive, comprehensive and ordered immediate adoption of legislation to create a single federal agency to control air space."

He advised Senate Aviation Subcommittee members to avoid "lengthy quibbling" over fine details of the emergency legislation in order to avoid any additional air response.

Blake charged that present regulations permitting military VFR flights in "isolated sections IFR airspace allow pilots to talk each other right." He said the basic reason "we do not" meet them, and by the simplicity of civilian and military flight is no longer adequate since the necessary time for civilian action is "practically gone." He added:

"Pilots can't sit on the edge of their seats for eight hours of surveillance and maintain a high level of efficiency."

Tactical Air Command Will Test First Production Line F-105Bs

Ft. Meade, N. Y.—Tactical Air Command's 17th Strategic, 14th Tactical Fighter Wing, is testing the first production line Republic F-105B Thunderbolt supersonic fighter-bomber here last week to start a new program of operational testing aimed at speeding entry of the airplane into service.

First aircraft was accepted by Gen. O. P. Wyland, commander of TAC who called it the first airplane tailored to the fighter-bomber role combining considerable maneuverability and outstanding tactical operations in World War II and the Korean conflict.

Operational Next Year

First stage of F-105B is expected to be operational next year. To speed transition of the Thunderbolt from test to squadron use the 17th, commanded by Lt. Col. Robert R. Scott, will turn over operational and tactical testing of the airplane at Eglin AFB, Fla. under a new USAF directive whereby TAC will carry out more functions previously handled by Air Proving Ground Command. The TAC squadrons will work with a joint staff from Weapon Systems Project Office, Air Materiel Command, Air Force Flight Test Center, WGC, Wright Air Development Center and Republic Aviation. Under the program the test squadron will follow the outline of the wing to receive the aircraft, eliminating test duplication with a central data collection.

Program is expected to share one to two years from previous time required for the acquisition of a new aircraft, even, also will require use of fewer

aircraft, providing in addition, a more economical program than previous. Other benefits will include defense facilities in the test program that is previous methods, also, all maintenance and logistical data collected will be immediately fed into test squadron records during the course of the program.

Production Comments

Volume production of the Thunderbolt will begin this fall. Republic's schedule calls for 1960 production contracts pending for 1961. Current contracts total over 5347 airplanes.

Gen. Wyland noted that the F-105B will be capable of conventional and altitude weapons delivery from two-top level up to 10,000 ft. Plus supersonic attack General Electric M55 for conventional cruise penetrating all altitude and altitude delivery by using upsets for post-battle delivery desired. In addition to nuclear weapons, the airplane can be fitted with rocket cluster bombs (400 lb) of conventional bombs, napalm, guided and engaged missiles.

In single GE T-70E1 Valves increased engine is capable of firing rate of 6,000 rounds/minute of explosive 16-mm shells using a new 1000-round rotary magazine developed by Republic engineers. Lockheed F-104 Valves is believed to have 6,000 rounds/minute firing rate. Since the F-105B has each of the two belts feed shells alternately with belts having 3,000 round magazine rate each. At 1,000 ft. the fire pattern is approximately eight yards.

When the Thunderbolt is flying at 3,000 mph, projectiles are trailing some 40 ft apart.

Among the Korean War losses ascribed to the F-105 are:

- Internal weapons storage permitting higher speed delivery and also drop-bomb.
- Capability of carrying varied loads of weapons for striking at large variety of targets using most efficient loads. Airplane's size rating takes into account large variety of external stores that are required.
- Stable platform for weapons delivery is possible by minimizing buffing and yaw through use of low-set tailplane and incorporation of large vertical fin. Pilot type drive bodies are also designed to minimize instability during delivery.
- Use of afterburners to get the airplane off from normal fields with heavy loads. F-105 is designed to get off in under 5,000 ft when in climb configuration, i.e., carrying internally stored weapons.

A 15th test unit, American Forces, that he believed the airplane will have superior altitude characteristics when tested than will the squadron's current North American F-100Cs which it is replacing.

Better System

An important feature in the airplane's performance is the computer-designed engine system which experts are taken through the down line, venting it through the tailpipe for a speed gain of approximately 15%.

Powered by Pratt & Whitney J75 engine of 15,000 lb thrust plus other features power the F-105B is a "man-Mach 2" airplane. Its distinctive jets, it is right back on the bank of capability of current F-105 cockpit canopy is not to take into temperatures. American Forces noted.

Later more advanced weapons will probably require a tougher material in the area. Plus the Collier communications, navigation and information package.

Republic currently has a bubble reflecting system using underwing testing designed around a standard 490 gal F-105B external fuel store. Tank will be used to hold fuel and some 150 gal of fuel.

F-105 is designed to carry four 490-gal capacity tanks internally plus externally stored fuel for air-to-air refueling.

Using KB 70 jet-control tank operating at 25,000/16,000 ft will also be used.

Later versions of the Thunderbolt include the negative F-105D fighter incorporating additional internal equipment and the tandem two-place F-105E ground attack version and the tactical all-weather fighter-bomber F-105F is expected to roll out in 1959.



McDonnell Unveils F4H Navy Fighter

McDonnell F4H, designed to be at least as fast as Mach 2, is said to have greatest range of any Navy fighter fighter. All-weather aircraft. Navy's first experience has been how jet, will carry various weapons and is capable of long-range delivery of conventional and nuclear bombs. Wing is swept back 45 deg., horizontal tail spans downward 25 deg. to improve handling at all speeds. Aircraft is 56 ft long, wing span is 38 ft 5 in. Side-mounted engines in canards at wing tips. Also with Square 28 all-weather radar mounted on belly.



Soviet Scientist Hits Long Lead Times

Moscow—A leading Russian space scientist has expressed concern over the long lead times required to bring new Soviet electronic equipment from the drawing board to mass production.

Writing in the official government newspaper, Izvestia, Academician A. Buzdakov complains that "the traditional conception of a new Russian electronic device and its industrial nature is fundamentally gross-out to seven years—whereas in the U. S. it is only one to two years."

"The misestimated M-1 computer, for example, was designed four years ago. The first models were built in 1958 and have been used intensively to date. Yet, the USSR State Planning Committee has already spent about a year trying to decide how to put this machine into quantity production."

Buzdakov also charges that the USSR's radio engineering and electrical industry "has not yet achieved efficient mass production of standard, miniature electronic parts, elements and power tubes, especially semi-conductor devices." Much of the blame for this situation, he asserts, lies with Soviet planning and coordinating agencies.

British May Produce Short-Haul Jetliner

London—Constructors of the Hawk, Hawk, Harrier, and Phantom, is considering production of a twinjet short-haul transport the P-137, designed by Hawker Aircraft Division is expected this summer.

Construction called Hawk Manufacturing Co.—was formed originally to produce the Hawk jet of the Hawk 120. P-137 reportedly would have two Bristol Siddeley engines, a 100,000 hp engine and seats for 90. Fully equipped, it would cost \$710,000.

firm integration over the Air Defense systems (Integration Division, at Cambridge, Mass., and changing Maj Gen Ronald A. Schaefer's title from assistant to the commander, ARDC, to deputy commander, Air Force Reserve Materiel Maj Gen K. P. Bergquist heads the new Systems Information office.

It is possible that Gen. Schaefer will be assigned to ARDC headquarters in Andrews AFB and replaced at Ballistic Missile Defense, Inglewood, Calif., by Maj. Gen. Don R. Gutierrez, presently deputy commander for resources at ARDC headquarters, although ARDC spokesman said there is "nothing official" on this report.

GE Turbofan Passes 50 hr. Test

By Case Level

Houston—General Electric Co. has completed a 50-hr test of its turbofan version of the T79 engine, and the new powerplant has logged over 100 hr on the test stand. First flight is expected in the fall.

New engine at a modification of the military F9 and civil C1805 designed to provide a more efficient powerplant on the Mach 30 to Mach 55 speed range. Details were revealed at the Asian Winter Air convention here last week.

Most immediate application of the turbofan powerplant, called an afterburner, General Electric, is the Comstar 501 transport, and the ability of the engine to provide increased efficiency and economy will be a key factor in airline decisions to fill out their turbine fleets.

Regene modification is expected to increase tieoff thrust of the home engine by about 55% and improve cruise fuel economy by 5-12% (AW April 14, p. 40). Regene is rated in the 15,000 hp class.

Explain more about 58% of the base
catalyst components of the [79 and for
C] 885 components

Altius modification is a relatively simple addition to the basic J79 engine. It can be produced as an integral version of a new engine, or it can be added as a modification to existing J79 engines.

Since the hypos are cut at a single stage compression has nearly all the cost of the engine run, a number of valves can be used, including variable or check valves near the rear of the engine. An advantage for hypos as could also be increased the length of the engine but the extra metal would contribute a weight penalty.

During an AWA convention stop in Corpus Christi Naval Air Station, Sikorsky demonstrated a new version of the S-18 with instrument flight controls.

of life sciences and command surgeon for ARDC was given title of special assistant for bioinformatics under the deputy commander for health sciences. He will remain at Andrews.

ARDC also has created an office of assistant deputy commander for space systems under the deputy commander, Weapons Systems, to handle new work in this field. It is headed by Lt. Col. Chantree C. Stedley.

Col. Carlos B. Tosta, former information services officer, has been named special assistant to the commander, ARDC. He has been replaced by Lt. Col. William S. Evans, Jr., formerly of Air Force Ground Center, Eglin AFB, Fla.

Cedar records, which will be submitted to *Pedicularis Anemone* Inter-nationals at world records, were flights to 3,000 meters (9,842.5 ft.) in 4:39 sec., to 3,000 meters (9,842.5 ft.) in 1 min and 6.13 sec., to 3,000 meters (9,842.5 ft.) in 1 min and 29.50 sec.; and to 12,000 meters (39,370 ft.) in 1 min and 51.34 sec. Records for these four altitudes have been held by the French *Gérald St.*

Decreasing high-carry capacity fuels: Robert A. Wells, CalZ Oil Corp. vice president, told an AWA session of a new material called triethyl borane which has been reinforced for propane fuels. Unlike other types, triethyl borane doesn't burn when exposed to air, but it has to be ignited before it shows its pyrophoric characteristics.

Other developments

New ground control system will be developed for Sonaric interceptors made by Westinghouse Electric Corp. under a \$10 million contract. Westinghouse will develop a more advanced system for guiding the missile during its flight to target area where infrared guidance system takes over. New system will replace Westinghouse system used in Sonaric.

•Dow Chemical Corp. has developed a new magnesium alloy with high damping capacity. The KTXI alloy will be useful in aircraft and turbines where vibration damping is necessary and especially in electrical equipment cases. Dow and

*New, small size Mach 3 capable density research wind tunnel for supersonic/hypersonic boundary layer research has been designed and built by Space Technology Laboratories Division of Rayco Worldwide Corp.

• **Condensate Trap and Rubber Co.** has decided that rubber adhesion is no bar to the use of rubber trays on stone inserts. After exposing stony teeth

In Corpus Christi, the Navy announced the new diving speed record set by Maj. Edward N. Lohrste on a Douglas F4D-1. Flying from Naval Air Station Test Center at Ft. Meigs, Lohrste flew to 15,000 meters (49,212.5 ft) in 2 min and 36 sec.

P&W Moves Into Rocket Field

West Palm Beach—Frost & Whitney Aircraft completed a major test last week in a program designed to increase the aircraft's performance by as much as 10% if possible in subsonic under engine and other cases for very high speed flight. The test involved the opening of a compressing duct, a very large duct in the building representing engine and a small duct in test area for turbine engine. During the installation of this ducted engine, attached to a 10 in. air duct on the edge of the Evaporator 14 Gas Chamber 5 from USAP, ducts of steel, stainless, aluminum that Frost & Whitney's expansion made includes work here with beams and bolsters (see p. 15). Part large design project (see p. 15) has moved to Florida in the US. (See p. 15)

SUPERSONIC Breaks Takes magnet-powered golf, made in conflict aboard U.S. Navy cutter *Colleton* (left), which was commissioned last week at Philadelphia. Made built by Breaks Aviation Corp., has wings of more than 50 in. At night, while in development is working toward with "dies" now except for pilot for visible in photo. Take is lightweight, a conventional version, which was sometimes used soon for launch on test, has first automatic located 80 deg. Most named members of crew. Several other plans will be fired with Take.

Talos Has Conventional, Nuclear Punch

By Philip H. Klein

Philadelphi—Two types of Ticonderogas—one with a conventional warhead, the other nuclear and employing slightly different guidance techniques—will be used aboard Navy's USS Galathea, first of a series of Ticonderoga-class cruisers. The Galathea was commissioned here last week.

Both versions of Tidon produced by Bendix Aviation Corp. are intended primarily for long-range fleet air defense but can also be employed against enemy ships or surface installations.

Range of the supermassive magnet pulled Tides is quoted as "more than 60,000 mi" and its level light output as "higher than that reached by our sun." The 1,000-lb., 30-in. dia. mass is 10 ft. long.

Sperry-designed radar is used to guide both types of Talos to target vessels long before other guidance techniques. Nuclear armed versions, for use against large formation targets, is detonated by radio command from shipboard. Conventional surfaced Talos, used against single targets, switches over to semi-active guidance in final phase of attack. However, in ex shipboard order energy reflected from target, laser.

Workload is determined by position-
ing. Conventional wired Tides are dis-
tinguished by low leaning guidance as
tides speed 90 deg. apart, as the new
Nuclear Tides has only eight tube.

Calibration is equipped with single-
 off mounted reticle launchers which
 can fire two rounds individually or
 synchronously simultaneously as required.
 Dual target tracking rails (AN/SPG-
 40) and two smaller guidance rails
 (AN/SPW-2), both Sperry designs, per-
 mit each round to be directed at dif-
 ferent, widely separated targets.

Vanguard Test

Navy attempts to place a 23 in. dia. Vanguard satellite into orbit failed last week, possibly due to malfunction of vehicle's pitch rate programming mechanism. Initial data indicated that all three stages fired successfully, that satellite was ejected and reached an altitude of approximately 1,000 mi before it plunged into the Atlantic. Radio signals were received from the satellite for approximately 35 minutes. Officials hope to launch another fully instrumented satellite sometime next month.

name Co., can be automatically reloaded in records. Another pair of Value numbers can be used to track or exclude and purchase orders are freed from previous, correct assignments.

Cebu, completed shortly after World War II but never commissioned, was taken out of mothballs two years ago for conversion to a light cruiser missile ship. She, reported to become operational this summer, will serve as a gunnery test bed for the Talos surface-to-air missile, the first real-time powered cruiser, the USS Long Beach.

Gabestan will be used to intercept capabilities of Taks with piloted interceptors in direct air defence. Gabestan is equipped with Taron transmitter which enables interceptors pilots to pinpoint their position and stay outside the range of Taks. Gabestan is commanded by Capt. János B. Csikófi, former deputy director of Navy's Polaris program.

Beady is prime contractor for Telo models but Vite Corp holds responsibility for integrating modules, graduate school's computers and other weapons support items. Airframe and target engine are produced by McDonnell Aircraft. Telo is outgrowth of John Hopkins University's early postwar Bechtel program.



ALPHA SECTION was from direction of the Assembly building. Explosion apparently originated between landing position four at its left and landing position three at center. Areas points to center about three feet deep where time and smoke warheads unexploded. One missile that was being installed as believed to have been placed. Metal framework has all been extensively pulverized by pellets from exploding warheads.

Nike Ajax Probe Nears End

Middleton, N. J.—Investigators of the explosion of eight Nike Ajax ground-to-air missiles at the site of Battery B, 33d AAA Missile Battalion here, is expected to conclude this week.

Batteries launching six canisters of three launching stations, each capable of launching four missiles without re-loading. Explosions occurred in Alpha section, the closest section to the Assembly building where missiles are installed prior to fueling and checkout of warheads. Ten persons were killed.

On the basis of physical evidence and accounts of witnesses, this appears to have been the sequence of the accident:

- Prior to the accident, battery had been at "red alert" status which was required for testing missiles about ground for operational checks of such active equipment as the missile's radio beacon. Our missile was at each of the 12 launching positions. A fire occurred before the accident, the battery changed from "red alert" to "yellow alert"—a ground as long as equipment is in operation—and prepared to accept.

- Three additional missiles had been brought above ground and placed in the Alpha launching section (the metal framework supporting the four launchers with the elevator to the upper ground storage chamber). These three missiles were positioned horizontally between the four missiles undergoing operational checking in their Columns. Corps technicians could replace the

missile among devices with an improved model. Thirteen Alpha section missiles (seven operational missiles, three and Charlie Sections each equipped four operational missiles).

- Explosions apparently originated with missile undergoing modification between launchers positioned three and four, the two positions closest to the Assembly building. To replace the missing mechanism, two of the three warheads in the missile (two and one warheads weighing 12 and 170 lb, respectively) had to be removed. Gun shot 12 ft. in front of position where the missile was suggests these warheads were lying on the ground at the time of explosion. At 170 lb, a cold missile in the launch with power could remove.

- Warheads are wrapped with several banded metal pellet cases about 0.25

in. to a tube. Detonation of the air warhead of the missile being modified would drive these pellets into the warheads and fuel tanks of adjacent warheads. Fuel for Nike-Ajax is not feeding into and is located. Explosions of other missiles could result from pellet impact on warheads, fuel lines, or fuel mechanism.

- All seven missiles in Alpha section exploded. Eighth missile was in launch position four of Beta Section, the next in adjacent missile. This missile apparently did not explode but had its location ignited by a strong sub-hat pellet which blasted the missile into the side of a nearby hill. Failure of this missile to explode may have saved the remaining missiles.

Nike-Ajax warheads use an explosive called Composition B—a relatively inert explosive somewhat similar to RDX. Missile is contained guidance type, fired by a "burst command" transmitted by the ground computer and transmitted by the missile tracking radar as a coded variation in the timing of its double pulsed transmitter.

News Digest

General Electric Co. has received USAF contracts leading to development of engines of more than 5,000 shaft horsepower for 195 jet engine which will power North American B-70 strategic bomber. Preliminary development work has been under way for several months at General Electric's Aircraft Gas Turbine Division, Farmdale, Ohio. Company said details of contracts and design are "highly classified."

Beggs' 940 Integral, four-engine experimental STOL, strength, has made its first flight at Vought's facility, near Farm Aircraft weighs 14,800 lb., is powered by four Turbomeca turbo-prop engines of 400 hp each. Later model will weigh 16,800 lb. and will be powered by four turbo-prop engines of 1,200 hp each.

Turbine blade manufacturing process, expected to reduce cost by approximately 50% over any currently used process, has been developed by General Electric's Small Aircraft Engine Department, Lima, Miss. Special roll and core methods, as pilot plant production by General Electric, overcome problem of economically making blades for T38 turboprop, which have a high ratio of useful thickness to platform width. Although designed for T38, process is easily adaptable to other engines, company notes.

Second Fairchild F27 is now being Aircraft will continue company's development program and B. CAA certification flight.



Sikorsky Studying Flying Cargo Crane, Transport Designs

Three advanced helicopter designs on Sikorsky Aircraft's drawing boards include top left, a 50-passenger high-torque type designed to meet International Air Transport Association scheduled inter-continental. Project has an auxiliary engine under tail for boosting forward speed. Even tail rotor system is planned to decrease side thrust loads that would be too high using a large single rotor. Another type (right) resembles low line. Five turbine 20-passenger HO4 will look at commercial service. Military model, with amphibious land, is scheduled the earliest next year. Los Angeles Airways is considering the ship for its latest fleet, using the designation Mark III. Adaptation of large two-engine HO4 to long range role, more conventional rotor to lower profile, is shown below. Details of rotor also provide crew member with optimum view for performing large loads of equipment.



Economic Study

Potential benefits has attracted his special interest Edward Gosselin, to conduct an intensive survey of the economic problems facing the aviation industry as a major part of its overall investigation of the U.S. economy. Paul C. Gosselin, assistant professor of the Harvard Business School, has been named by Gosselin to gather behind data pertaining directly to the economic of the entire industry.

Transatlantic Charter Growth Foreseen

Scheduled carriers anticipate 10% traffic increase above last season's 50,000 charter passengers.

By Glenn Ganssion

New York—Economic firms are not altering the growing transatlantic charter business expected to total about 100,000 transatlantic passengers this year.

This estimate means a steady passenger flow in each direction, in the same way that scheduled traffic is composed.

Scheduled carriers whose summer charter traffic totaled about 50,000 passengers last year, are producing an increase of about 10% this year in the business. Non-scheduled airlines that will carry the rest of the traffic have expanded their fleets and introduced new, less costly, passenger aircraft on the North Atlantic.

Industrial companies, particularly steel, insurance, petroleum, are accounting for an increasing share of the charter business and the potential of this market is considered potentially untapped. For those who can qualify, participation in such a group to share costs makes possible a European vacation beyond their means with the season's end.

Roundtrip passenger rate to London is \$155.00; charter firms indicate this is 51% off and up.

Carl Armeringer Reed this year has modified its charter policy to serve executives, selling out seats primarily also in Europe in a charter group and have it to be handled. This has made things a little easier for the charter operator, particularly the non-scheduled carrier, and for the travel agent and charter applicant.

A fit in the charter business this summer is the U.S. business season, which is having more effect on the industrial group business. Unlike with domestic business considerably, however, the season is expected to be the best one yet. The non-scheduled DC-4 down to a scheduled this season on the Atlantic is becoming an asset instead of a liability in some ways because of the capacity problems in some groups who have chartered larger planes like wide-body aircraft for some of their members. As cost per head depends on the number aboard these groups are looking for smaller planes with less capacity than the DC-4.

Among the charter operators on the Atlantic are:

- Pan American, whose passenger charter business last year totaled 33,309 seats on its own Military Air Transport Service contract traffic, but the MATS share not considerably under half," according to PanAm. The airline's MATS business has dropped considerably on the Atlantic in the past two years. Basic commercial charter equipment in the DC-6E, with recent tourist configurations of 71 passengers. Seat pitch and service also follows the tourist class pattern, which indicates that much, with some rates with season and duration of stay of outboard charters are cheaper in the fall, for example, when scheduled traffic movement is predominantly westbound. Passenger charter revenues last year totaled \$91,756,000. PanAm attaches considerable importance to the industrial charter market and cites an outstanding example, Fokker/Quaker Group, booked for next winter season this fall for 7,000 employees in PanAm charters. The airline, meanwhile, helps such industrial companies in that its providing special menus, potpourri, between the like for the comfort of which the customer are the price. PanAm says its 1978 charter business will be about 10% greater than last year's.

- Trans World Airlines, with 31,311,000 in transatlantic charter revenues last year, earned \$374,000 from this source in the first four months of 1978. TWA expects to better the 1977 volume this year and to get more off season business.

- KLM Royal Dutch Airlines, second in PanAm's ranking of the scheduled charter operators on the Atlantic, handled 14,100 passengers last year, 9,800 of them during the peak season—June through September. KLM also is getting an additional company expansion, however, before expects an increase this year of 10% in revenue 1977, as all seven charter wings.

- Flying Tiger Line, largest charter operator on the North Atlantic in either the scheduled or non-scheduled class, handled about 11,800 commercial charter passengers last year between the U.S. and Europe. Another 15,000 people in MATS work, and 10,000 Intercontinental Committee for European Migration charter passengers brought the charter total to 40,000. Greater aircraft revenues totaled about \$51 million. This year, MATS business is due to off

about 10%, ICEM air charter seats seats are temporarily at a standstill, but commercial charters are expected to run about 20% ahead in 1978.

ICEM assessments into this country amounted to 41,494 passengers in 1976 against 21,066 last year. Flying Tiger has handled about half of all the airborne charter traffic which began to move in 1974 under the Refugee Relief Act. ICEM expects to move 11,800 people to the U.S. this year, 68% of them by air.

Flying Tiger sees it as finding increasing competition from both scheduled and contract carriers for commercial charter business. Industrial groups are much more aware of FTL's charter facilities, perhaps 15%, but the potential is considered very low. "Island groups" such as clubs, national organizations and college groups make up most of Flying Tiger's commercial business. The summer Flying Tiger will see the first of its Super II Constellations on the Atlantic, in two configurations—114 passengers and 96 passengers. Four passenger jets, such as London Heathrow and Paris at about \$300 round-trip, service includes free hot meals, drinks for sale and the attendance of three stewardesses.

- Transocean Air Lines has put four B-707 Constellations in the Atlantic this year, replacing DC-8s which handled 30 commercial charters last year in addition to MATS work. The Constellations are mostly acquired from a foreign airline. Transocean expects to handle about 40 commercial charters this year, with aircraft configurations of 50 seats maximum. That results, no drinks round-trip, less to London \$351.50, as \$278.00 a head, depending on whether the first leg of the trip is made in the peak or off-peak season, and on whether industrial groups, corporate, approximately 20% of Transocean's commercial business. Although the airline is afraid the recession may cut this business back, it aims, rather.

- Overseas National Airlines has shifted its charter effort to transatlantic commercial charters is far as the season is concerned. ICEM, formerly handled most MATS, ICEM and other airlines contract work. It hopes to fly 100 commercial charters this year in three: two DC-6As and in DC-8 Overseas National's new headquarters from Oakland to Baltimore to concentrate on the Atlantic, especially New York charters.

- Island groups such as C. Bennett. It says season charter business to Europe has grown in the past five years to a \$25 million volume in transportation alone. Bennett's industrial groups is the great market for business charters. Its company will make offers to all group operators on the idea of planning next year's rates from June or July in the season instead of handling in the peak weeks. Overseas National charges \$25,579.50 or \$29,575 for a 97-passenger DC-8A depending upon the season, direct route, non-stop, and \$27,915 or \$30,944 for a 68-passenger DC-4. Three peak weeks set to \$261.50 per passenger round-trip. Hot meals, drinks if desired, 36 in. seat pitch. Industrial groups are making up some 80% of Overseas National's charters this year.

• U.S. Overseas Airlines will divide its 81 DC-4s, two DC-8s that summer between supplemental commercial and charter flights. Cairns says revenues has helped its charter business become groups "have drunk to our side." Full



Production Boeing 707s fly in formation for first time

Boeing 707s formation flying in formation for the first time, past over Mt. Everest, Wash. Top picture is the first production 707 which made maiden flight Dec. 20, 1957. Bottom aircraft is the first production 707 which flew for the first time May 25, 1978.

potential of industrial group business has not been to be tapped, according to U.S. Overseas.

The passage figures for charter operators actually represent only a part of the total passengers handled in the work. If 97-passenger charter a plane, 45 in Europe and others, this count is 97 passengers. And if the plane position head round trip on scheduled flights would be considered 144 passengers.

Furthermore, the charter operator is not going to leave his group in Europe and its back copies of his own help. The non-scheduled operators want to do some much averaging to find west-bound lines to fill up their backhills. Besides being MATS or ICEM charters, such groups in shape must be much in demand as charter customers to solve this backlog problem. And there do not show up in the charter totals.

Probing this all but business for backlog traffic is a complicated and

competitive affair for the charter carrier. Bidding for summer groups—wholesalers or "single orders" charter—paid for by the shipping company results in prices much lower than the prices for other group passengers. But both, under CAB's watchful eye, are not to be less than the basic fare. Charter operators need \$2.50 per mile as the rate of charter, not bottom point in negotiations.

CAB this year has clarified its policies regarding eligibility for charter groups and has published a questionnaire to be used by the carriers in determining whether groups are qualified, and a stand still after-flight report. Non-scheduled operators, who must apply for an operating 60 days in advance of a particular flight, do not, this year, have to offer Fokker and TWA first refusal of each trip as they have in the past. This change, however, applies only to non-scheduled charters.

The Board's new policy defines

also makes more explicit the relationship between the haul agent, who loads most of the charter business, and the traveling group. Agents' commissions are limited to the actual International Air Transport Association 550 rate.

CAB also spelled out more clearly its role in actively recruiting airlines and solicitors of groups, and a review of other regulations concerning the organization, payment and handling of such groups.

The growth within the last few years of the scheduled regular charter, along with continuing business from other eligible groups such as teachers and national groups would seem to confirm

view that the great mass travel market upon which future transatlantic business may depend, is largely satisfied at present fare levels.

What will become of the charter business when the vastly expanded jet age scheduled capacity is being the Atlantic—and other routes—in a most and complicated manner.

For example, Pan-Am's total jet capacity will be about 70% greater than its piston fleet capacity. If the carrier for most parties already is glibly to than is mass, charter parties it may be. Butcher could use its Mediterranean DC-6Bs—41 of which will be with two DC-7s that have—in a highly flexible charter fleet.

the public movement and aircraft." CAB told the airline has agreed to accept a final mail rate code established by the law, for each of the five years during which the law is to be applied, and that on expiration of the period on this final mail rate will be applied. But the law is based on data and estimates set forth by New York Airlines in connection with the law's passage.

46-2 Interior

The International Ventrals in New York Airlines serves out 12 passengers in each of the four seats of the aircraft with two on luggage. Another two are seated on the floor. Two additional seating seats are installed in the front of the cabin, and the 19th seat is located at the extreme rear behind the entrance door. Doors in the cabin, and rows and gold seats are equipped with standard safety over head reading light and an outlet built in.

Particular windows get passengers a Viewpoint view. None less is less than 5-10 ft.

The permanently installed bathroom, just two outboard from aft and a front flush against the fuselage structure, weighs about 340 lb. together with the fixtures and which makes the Ventrals' outside weight according to the manufacturer.

The gear was developed by Ventrals. It is said to be able to take full loads from the aircraft's landing speed.

New York Airlines' 44-100 jet is equipped with the Smith-Dixon seat, which offers for optional reduction under a contract with American Airlines. The seat is said to be the only one developed since 1940.

Continental Starts Viscount II Service

Continental Airlines has a new special scheduled service on its new Viscount II. The airline's first flight on the new aircraft, Chicago to Los Angeles route. The 30-passenger plane will be used in daily five-day flights.

Continental is buying 11 of the Viscount II. Each will fly on the Chicago to Los Angeles route. The airline is also handling with 35-passenger DC-7Bs. Continental has also ordered Boeing 707s and plans jet service in the spring of 1959.

The airline's first class Viscount service will feature first class meals, first class food and drink, gold buttons, champagne dinner and supper. New stewardess uniforms have been designed, including wrap-around coats to be worn while waiting on drinks are being served. The airline is also adding gold, with treatment seating and a new lounge.

Subsidy Bill May Spark Industry Battle

By Fred Eastman

Washington — Proposed legislation that would permit domestic trunk airlines to open receiving subsidy payments is expected to touch off a bitter battle within the airline industry.

The larger trunklines, despite declining profits and heavy commitments for jet equipment, have requested support of the proposed bill. The smaller airlines have expressed considerable concern over the impact such legislation might have on their future and, in fact, dozens of them oppose it.

Early proposals, sponsored by Sen. Strom Thurmond (D-S.C.) and Davidson B. Martin (R-S.C.) and Representatives F. F. Mark Jr. (D-Ill.) and John F. Mize (D-Calif.)'s legislation of domestic trunklines for subsidies would be eliminated permanently.

Supporters in both the House and Senate said the bill would not affect the smaller airlines, but would subsidize trunk, local service and helicopter operations.

A spokesman for the local service industry said, however, that both bills contain a provision that would leave a window open for local service or feeder line operations.

30-Mile Clause

In addition to clarifying trunkline subsidies the Senate bill would prohibit subsidy payments for any new route longer than 30 miles and parallel with a route already operated by a non-subsidized carrier. The House version would prohibit subsidy on routes of 100 miles or more in length under similar conditions except for the first two miles of local or feeder service.

Supporters of the proposal and the bill said government has spent nearly \$200 million in subsidies between 1938 and 1957 in "helping develop the finest aviation system in the world." They added that they feared the time has arrived for a "reappraisal of the entire subsidy program."

Wider Backing Claim

Barber of the legislative clerk cited scores of subsidies for trunk airlines could have the following results:

- It would require more careful and efficient management of the larger airlines.
- It would eliminate the possibility of an unnecessary subsidy burden ever again falling on the general taxpayer.
- Regulation of the domestic trunk airlines and feeder routes of new routes could have to be based on more careful analysis of the needs of the public and the economic conditions of the airlines.

and less on regional and other services in class.

It would permit substantial competition, such as adding a fourth airline to a route where three operate profitably and the traffic points unaffected by support from Congress. The Civil Aeronautics Board finds that local trunk airlines operate to affect operating losses of one or more of the carriers.

• It would eliminate a long-standing area of CAB responsibility and thus increase the efficiency of that federal regulatory agency.

Big Four Support

Airline representatives in Washington predict the Big Four Airlines, Eastern, Trans World and Delta Air Lines will lead enthusiastic support to the subsidy legislation. Airlines of this size have often criticized the CAB for providing "multiple competition" on high density routes.

They claim that in many cases where routes are operated at a reasonable profit by one or two carriers, the addition of a third or fourth carrier often results in an overall operating loss for all or several.

There are more airlines serving between New York and Washington than before World War II there were two. There are five airlines flying between New York and Boston and five between Washington and Boston.

There also are five between New York and Detroit and six between New York and Chicago.

In some instances where the biggest carrier has been able to show a profit and get off subsidy, additional airlines were put in the market that still required subsidy.

Multiple Competition

Although no trunkline are receiving subsidies at present, multiple competition in markets that still support it may force some carriers back on to, or into, the subsidy situation. Not only must the taxpayer stand the expense of the additional and unnecessary competition, but it wastes the economic value of the airline simply by the market, where more and better service could be provided with fewer carriers, they add.

The smaller carriers claim they do not submit to get back on subsidy, but that they cannot do so without the help of their legislature at a time when airlines are facing their greatest financial crisis. No one knows what to support in the future as the industry moves into the jet age. One spokesman said that the cost of such subsidies would be too great to consider.

subsidies, including the biggest airlines. However, the small airlines on such legislation might not be able to create a monopolistic situation where competition of the Big Four could be eliminated in law.

Financial Fight

CAB's policy of strengthening smaller airlines by providing them access to high density markets has been a major factor in enabling all the trunklines to get off subsidy. However, it is possible that airlines operating in smaller markets may feel a serious financial pinch during the transition to jet when the subsidies of subsidy might mean the difference between continued operation or bankruptcy.

The large airlines answer to this is that the CAB is only permitted to grant subsidy in other operating losses and if the losses are a result of an unreasonable competition, then it should not be allowed.

The small airlines also contend that removal of eligibility for subsidy by law might tend to require them could merge with the financial community and to clear their ability to support the necessary financing to purchase jet equipment.

Doty Appointed Transport Editor

Laurance I. Doty has been appointed transport editor of *American Ways* effective June 3. Doty's appointment is part of an editorial expansion program aimed at improving the quality and completeness of *American Ways* as a source of airline information. He will now be headquartered in Washington, D.C.

Doty has been an associate editor covering air transport for *American Ways* for the past two years. Previously, he was manager of Capital Airlines' public relations department in New York.



LAURANCE I. DOTY



PASSENGERS board a New York Airways 11-passenger Viscount 44B at West 30th St. Helport in Manhattan. Shuttle serves helport, LaGuardia, Newark and Midway.

Three New York Airways Vertols Begin Scheduled Passenger Flights

New York—Three of New York Airways' new 11-passenger Viscount 44B helicopters went into scheduled passenger service last week in the original schedule between LaGuardia, Newark and New York International Airports. Flights into Manhattan's West 30th St. Helport were scheduled to begin later.

The helicopters' value exceeds delivery of its fourth and fifth DC-8s. The new plane, entering on flight of September 5-10 and 5-15 and doubling the seat capacity in metropolitan New York area service.

With the Viscount fleet New York Airways can fly 600 people in 44 flights a day in and out of Manhattan.

Loans Underwritten

CAB member G. Joseph Martin noted at municipal committee last week that the helicopters were the first aircraft to be delivered with the assistance of recent legislation providing CAB to underwrite loans to local service airlines for new equipment purchase.

Western-Alpa Strike Pact Nears

Los Angeles-Substantial progress has been made last week toward reaching a deal agreement on the Western Air Line Pilot Association strike which would enable the airline to resume service sometime this month. Alphas have been persuaded more than their dues, mostly already.

Although indefinitely still on strike, pilots and company representatives have signed an agreement on terms laid down by National Maritime Board Member Lester Lohrman, under which:

- Both parties were to enter a five-day negotiation period on wages, hours working conditions etc.

- A seven-day automatic strike deadline negotiation period was to be substituted for arbitration, with both parties bound to comply with arbitrator's final findings.

- No strikes are anticipated by either company or union in negotiations and arbitration process and company has already begun studying employee hardship by the strike.

Company and union members have signed a separate interim agreement on the issue of immediate relief. Under this, pilots will only fly 50 days prior to starting Lockheed Electric operations, and at the same time may accept negotiations on this issue only if at that time negotiations should fail to settle the deal. Also, another strike may be called after complete procedure specified by Railway Labor Act has been carried through. However, it is hoped that in the meantime, a provisional working agreement for the on transport industry will have been reached which can serve as a pattern for settlement of the controversial issue for all airlines.

Rates of pay for the flying operational (Miles) rates per mile for a minimum number of flying hours and supervisors to pilot minimum plus for the same reason still pending. In 16 days are being discussed.

If all points were settled immediately, there would be a time by before Western could resume full operations. During the lengthy delay Western pilots' operations facilities have expired, making it necessary for them to be re-trained and re-certified. Strides would be given whether return. Flights will have to be thoroughly checked and checked prior to being put into service.

First engines being needed are to be replaced by new technicians and inspectors and inspectors for servicing aircraft.

FL 7,380 lbs, and Class III, 15,000 lb and up. Specific structural requirements to match the gross weight of engines will be incorporated by air engineers. However, both Type 2 or 3 for vertical clearance of steel concrete slab, should be adequate.

Australian Carriers Purchase Electras

Perth, Calif.-Lockheed Aircraft Corp. last week announced the sale of four Electra turboprop transports to three airlines in the Australian New Zealand complex and the confirmation of an order order for two Electras by a fourth Australian carrier.

The purchases total a total of 11 Electras valued at \$27 million. They are:

- Qantas Empire Airways of Australia (Qantas)-four Electras

- Tasman Empire Airways of New Zealand (TEANZ)-three Electras

- Trans-Australia Airlines-Two Electras

- Ansett Australia National Airways was quoted previously to purchase two Electras following a reversal of an earlier Australian carrier decision that prevented the carrier from buying any more aircraft other than English made Vickers Viscounts (AW April 14, p. 4).

Sale of the 11 aircraft in the four carrier's leaves the Electra backlog to 151 aircraft valued at approximately \$125 million.

Qantas will operate the Electras in the East Asia sector of its around-the-world service. Deliveries will begin in the last quarter of 1959. TEANZ also has an order for two Electras on order for deliveries beginning in April, 1959.

TEANZ will operate the Electras in routes connecting the Fiji with Australia, New Zealand, Sydney and Melbourne. Two of these Electras will be delivered late in 1959.

Delivery of the domestic version of the Electra to TAA and Ansett Australia will begin in the first quarter of 1959.

In London, news of Australian and New Zealand purchases of the Electra drew angry comments from members of Parliament. One commentator in the House of Commons said "it will be a disaster if we allow these Australian and New Zealand contracts to pass into American hands."

Correction

Design D6C jet transport prototype is scheduled to make its first test flight at Edwards field early June. Due to a telephone transmission error, the May 16 editorial stated the initial flight would be made in November.

SHORTLINES

• Air France has extended its Paris flights from the Denver, London, and Lima, Peru, using Lockheed Super-G Constellation. The flight departs Baguay on Friday at 9:30 a.m., arrives in Quito at 11:40 and Lima at 4:13 p.m. The return flight leaves Lima Saturday at 8:00 a.m. Both first class and tourist accommodations are available.

• Emery Air Freight Corp. reports a first quarter net income of \$80,150 as compared with \$117,196 for the corresponding period last year. Gross revenues for the period were \$2,194,111 compared to \$1,234,957 in 1957. The increase in gross revenues, attributed to a 7% increase in shipments handled, was offset by a decline of 16% in the average weight per shipment. Rates has added routes from the U.S. to Hawaii in the international flight handling operations using all aircraft from the U.S. awarded to Hawaii.

• International Civil Aviation Organization has accepted Costa Rica as its 73rd member.

• KLM Royal Dutch Airlines will inaugurate a new route from Amsterdam, Tokyo and Bali, Netherlands. New routes are to be flown in both directions twice a week and will use Douglas DC-7C aircraft. KLM says there will be a regular intermediate landing at Bangkok, Thailand. The airline's scheduled weekly service between Amsterdam and Bangkok, depending upon the prevailing wind currents.

• REAL, Brazilian International Airlines, pending ratification of modifications on the Brazil-U.S. bilateral agreements, plans to begin operation of a Brazil-Bahia service later this year. The new route, under Lockheed Super-G Constellation, is expected to run from Rio de Janeiro to Caracas, Mexico City, Los Angeles, Havana, Wake Island and Tokyo. Current REAL transport schedule will operate the route following scheduled flights in 1959.

• United Air Lines will construct a \$1 million training center on the campus of Calicut University College in Denver. The facility, a half mile from Denver airport, will contain classrooms, recreation lounges, cafeteria and hangar hall. The center building will be used to house flight crew who train there for long training period. The center will be used to train diversions and flight crew as well as supervisory and management personnel.

AIRLINE OBSERVER

• Airline traffic which started an upswing during the first weeks in May, declined slightly in some areas following the mid-air collision April 23, near Reservoir, Md. However, availability of heavy passenger loads prior to the May 1st weekend, and the fact that most of the aircraft with scheduled services are May of last year.

• General Electric will have its C565 two-engine jet engine certified for both low-level and IFR flight. Company has been testing engines on low-level for several months. One C565 test engine assembly has accumulated 500 hr, an increase with no significant difference in fuel system on one. Low-level testing operations compared with results with IFR. Target date for C565 type certification of the C565 is July.

• Civil Aeronautics Board is making a detailed survey of the effects of aerial bumps on civil aviation patterns. Major point is to determine whether airlines can be defined legally as aircraft before scope of Board's jurisdiction as airspace activities can be established.

• American Airlines proposed to the Civil Aeronautics Board to provide such service with any type of aircraft on flights that depart originating terminals between 10 a.m. and 3:55 a.m. has been suspended and will be investigated by the Board. Both United and TWA find compliance against the American tariff flag.

• Carib Airlines, United Air Lines senior vice president, predicts that Congress will continue in the airline industry's economic problems if the Civil Aeronautics Board does not allow a substantial first increase.

• Trans World Airlines has been awarded an Air Force contract for \$2.1 million to produce communication equipment for Lockheed aircraft that would be assigned to the military in the event of surface emergency. TWA will produce the equipment, take delivery, install and hold the delivery in terms of storage room for all Lockheed aircraft operated by the scheduled airlines under the Civil Reserve Air Fleet program.

• British Overseas Airways is studying revenue increases that can result in more aircrafts in all engineering and maintenance procedures with a new aircraft, in particular. BOAC anticipates current financial difficulties is put to delay delivery and testing problems of the British Overseas which is pointed at a "very late arrival." BOAC admits it looks forward to further better expansion and new route development although it plans to extend its current flight, but expansion program to include new routes to London and Washington at New York, London, Amsterdam and Boston. Logan Airport next month. The route has been conducting training flights with the Carib between London and Gander.

• Air Lines has ordered three more Vickers Viscount 700s to be built at total cost of \$1.2 million. They will replace the four Viscount 700s now operating by the airline.

• Airlines are not reporting any loss of mail this year as the result of strong competition to meet the fact that many congressional leaders of both parties. However, a number of Senators continued to pressure a fight for cuts on the transportation costs in.

• Pan American World Airways expects passenger bus traffic on the North Atlantic will account for 70% of its total traffic this summer.

• Continental Air Lines has filed a petition statement with the Securities Exchange Commission for public offering of \$12 million convertible, subordinated debentures. Funds will support expansion costs of routes and services.

• Trans World Airlines has asked the Civil Aeronautics Board to remove restrictions on the Los Angeles-San Francisco route. The airline charged that "United and Western are not lifting the load" of the market and the airline to Board to lift "the oldest operating restriction in the industry" by granting an immediate landing and expedited handling.

on years, worked for United Air Lines in the Midwest and was a reporter on daily newspapers in Wisconsin. During World War II, Doty served as a captain in the United States Army in North Africa and Pacific theaters.

Attending Doty in the transport department will be Glenn Garrison in Western World's New York office and Robert H. Cook in Washington. Cook is a former Virginia newspaperman who came to American West from the Post of New York. Airlines aviation publication section. Cook, a Western Airlines newspaperman, was with Capital Airlines for four years before joining that magazine's transport department.

Los Angeles Group Proposes 'Helistops'

Los Angeles-Airline to get a new category of landing area recognized and to obtain city code changes required to meet local airline activity wing transportation potential has been recommended by the Los Angeles Chamber of Commerce.

The chamber has recommended that proper channels, proposals for changing city codes to:

- Make the necessary declassification between "helicopters" and other wing in

vertical takeoff and landing machines such as helicopter. Proper winging effects such things as airport and help port area, operations from certain areas in the vicinity of the airport.

- Establish new helicopter operating base to be termed a "helistop," a place for loading and unloading passengers or cargo only, as opposed to a heliport, where passengers can be landed and such operations as refueling, main structure and the like are carried out. The "heliport" could be a helistop too, could use and use the elaborate facilities required when landing in similar work, it to be accomplished. "Helistops" could be established in some areas where heliports would be impracticable.

- Have city building structural steel code system in a state, define what resources would have to be made to accommodate a "helistop," according to the category of equipment to be operated into and out of the site.

Request for changes to building code have been submitted to city council chambers, and while the Chamber of Commerce recommendations did not incorporate specific structural values for structures, a categorization of operational helicopters which would suit a "helistop" was made. In this, class were divided according to vehicle weight, Class I being 1,500 lb., Class

Basic Factors Complicate Plasma Work

Recent advances in the potential applications of the field of magnetohydrodynamic (MHD) are being made today by extending the study on the fundamental of the subject. This is an important step in the progress towards the application in various fields of science and technology.

By J. S. Bohn, Jr.

Magnetohydrodynamic—The present position concerning magnetohydrodynamic (MHD) is being made today by extending the study on the fundamental of the subject. This is an important step in the progress towards the application in various fields of science and technology.

Research into and applications of magnetohydrodynamic (MHD) are currently being made by the large number of factors that must be considered simultaneously.

Extremely wide variety of practical engineering uses and theoretical applications for external phenomena are possible when the electric and magnetic fields are applied to the plasma. The basic principles of magnetohydrodynamic are influenced by externally applied fields.

Magnetohydrodynamic, the problem with MHD is that it separates the two major two theories. Magnetohydrodynamic and electrodynamics each of which must be described in three-dimensional space. This has led to difficulties in describing the situation in dealing with magnetohydrodynamic systems.

Even an abbreviated study of these difficulties requires a few sections. An internal gas in plasma conducting a current creates a magnetic field about itself. The electromagnetic action accelerates the gas, and the gas motion changes the current flow which alters the magnetic field. These electrical and magnetic changes again affect the motion of the gas which further alters the fields and so on with time.

Another indication of the problems of dealing with gas particles which obey the laws of fluid dynamics and electrodynamics is given by Walter M. Elsasser of the Scripps Institution of Oceanography, a noted theorist

on the field. Elsasser has this to say: "Now, turbulence (which does not exist in two dimensions, but it does exist in three dimensions) What happens in a turbulent motion (which is not a body's mass)?"

This is not the end of the difficulty of the problem, however. Energy losses from radiation and gas diffusion through the containing magnetic fields are more considerations to any work with magnetohydrodynamic. The latter requires a knowledge of the properties of the gas and the properties of the magnetic field.

Two principal areas of possible engineering usefulness of MHD are being discussed today. The first has to do with such problems as in space vehicles, improving vacuum systems, possibility of making nuclear reactors, building in space through a radiation barrier and even the possibility of making a gas jet. The second area of possible engineering usefulness of MHD is in the area of space vehicles, improving vacuum systems, possibility of making nuclear reactors, building in space through a radiation barrier and even the possibility of making a gas jet. The second area of possible engineering usefulness of MHD is in the area of space vehicles, improving vacuum systems, possibility of making nuclear reactors, building in space through a radiation barrier and even the possibility of making a gas jet.

E. L. Ginzburg of the W. W. Hansen Laboratories of Physics at Stanford University explains this type of work.

"Nearly all radio-frequency generating devices employ electron currents; in retrospect, this seems like an artificial restriction upon the potential of electronic devices." He goes on to indicate that he expects the use of fully ionized plasmas and some degree of a means of improving the power level and efficiency of microwave systems which is as promising as the new Maser system which do not employ electrons at all. The use of plasmas in microwave systems is believed to have been suggested first by the Russian Physicist. Experiments along this line are known to be in progress in the USSR and Switzerland as well as at several U.S. universities.

The second general area of possible engineering usefulness of magnetohydrodynamic systems is in the area of space vehicles, improving vacuum systems, possibility of making nuclear reactors, building in space through a radiation barrier and even the possibility of making a gas jet. The second area of possible engineering usefulness of MHD is in the area of space vehicles, improving vacuum systems, possibility of making nuclear reactors, building in space through a radiation barrier and even the possibility of making a gas jet.

A highly simplified model of a three-dimensional system (MHD) is a system capable of producing a steady-state current in a gas jet. The gas jet is contained by a magnetic field (created by coils) which enclose the container. These coils are the electrodes

Magnetohydrodynamic Regimes

Complete elimination of gross magnetohydrodynamic effects would be an impossible task at present. However, Arthur Kesteven of Ames Research Laboratory has obtained the vacuum action region in one of the most recent studies. In this case, the magnetic pressure of the gas stream field is approximately equal to the kinetic pressure of the ionized gas so that a magnetic action effect is present and a transfer of energy and momentum takes place between the field and the gas.

The curve above and the material below are simplifications of Kesteven's work which consider only gas that is in a thermodynamic equilibrium (the thermal energy of the electrons and the ions is equal). The low temperature boundary of the curve is the temperature necessary for 10% ionization of the gas and is the right boundary in the temperature range which the electron is relatively

To reach the conditions shown above, the gas must pass in some manner through an ionization effect. They indicate situations in which the pressure of the magnetic field and the gas pressure are not equal vacuum degree of ionization exist, equilibrium between gas particles and electric fields exist, and thermodynamic equilibrium does not exist in the gas, in some case of the possibility. While the plasmas occurring in many of these other cases are of great interest in many fields, the plasma represented above is probably of greatest interest to those who want to control the thermodynamic system and use it as a propellant and to generate power. The curve on the curve shows the thermodynamic system and the electron and ionization curves (see comparison in K. F. that Kesteven's work on classification of several types of gas is important in completely describing the system of an ionized gas.

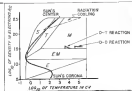
He used these lengths as a base rather than several frequency ratios which would have divided this phase into about twenty the same regions.

These lengths are defined roughly as follows:

- Dimensions of the apparatus—measured to be one centimeter or more in order to be considered as boundary approximations rather than actual observations.
- Mean free path—distance through which a particle must travel in equilibrium before it is scattered.
- Larmor radius—radius of the helical path followed by the electron and ion in a magnetic field.
- Debye length—distance by which the positive and negative charges in a gas will be separated if the thermal energy of the gas is not completely compensated.

The Debye length is measured here in terms of probability theory and is a method of determining the density of a gas of particles expected to be found in a given volume. It is a property of a plasma of particles velocity, the magnetic field, the electric field and a collision time.

Regions included in the magnetohydrodynamic regimes (see Kesteven '55)—Collision time is measured and the particle distribution will be close to the Maxwell distribution in a neutral gas. The electron and ion will drift through such a gas as a neutral result in the direction of applied magnetic field. The drift velocity will be parallel to the magnetic field applied by the electron and magnetic fields. This region is known as the 'S' region because the electron conductivity is a simple scalar quantity and equal to all directions. Larmor radius is large, compared to mean free path.



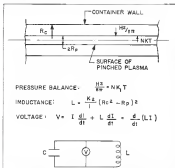
REGION 'T'—Helium ions are the most difficult to control by the electron beam in a region 'T' and 'M' regions such as in a plasma which is controlled by the ion motion will not be appreciably affected. The electron Larmor radius becomes smaller than the mean free path, however, and the magnetic field becomes dominant in the electron Debye length. Helium ions are still important, however, and the distribution function will still approach thermal equilibrium. The drift velocity of a charged particle in a magnetic field is perpendicular to the magnetic field. This is the case in a plasma which is in a region 'T'.

REGION 'M'—Both the electron and ion Larmor radii are smaller than the mean free path, and both Debye lengths are dominated by the magnetic field. The magnetic field does not interact particle movement in the direction of the magnetic field, this must be controlled by some other agent such as a valve or a magnetic field. In the high density, low temperature region where the mean free path is still smaller than the Debye length, the plasma will still be ionized. At higher temperatures, the plasma will be ionized by the random motion of the remaining magnetic field. Collisions are still important in the ion motion and the electron Debye length. In the upper left hand portion of this region, the mean free path is close enough to maintain thermal equilibrium. Below this region, the mean free path is too long to produce the required density of electrons. One of the principal reasons for interest in this region is that it contains the gas region in which it is anticipated that fusion reaction will occur. It also is a region frequently encountered in astrophysical plasmas.

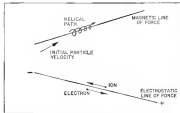
REGION 'E'—The ion Larmor radius is larger than the mean free path, but the electron radius is still longer than the mean free path. In this region, the ion motion will be essentially free particle motion in the electron field maintaining the thermal neutrality of the gas. The electron Debye length is still dominated by the magnetic field and the electron radius is still smaller than the mean free path.

REGION 'C'—At all lower densities, the electron Larmor radius also becomes larger than the electron radius. The principal reason for interest in this region is that it is not controlled by a magnetic field which the magnetic pressure is large compared to the gas pressure. This is the region in which fusion reaction is most likely to occur.

When the Debye length becomes greater than the size of the apparatus there are no longer any interactions between gas particles. Therefore, it is no longer necessary to describe the motion of the gas in terms of fluid dynamics. An individual particle description is then required.



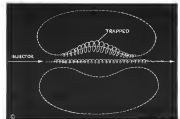
FUSION reaction producing electron power directly would keep plasma between containing magnetic field (left) and plasma (right) ions. Gas surrounding container could be ionized and then inductance is dominant in plasma and container mode. When magnetic pressure dominates, plasma is squeezed and fusion reaction occurs. Plasma pressure then produces field back inducing current in coils and changing conditions (lowest diagram below).



MOTIONS of a plasma particle in electric and magnetic fields can show how it is put through field alone produces linear acceleration. Magnetic field causes helical motion but does not give transverse acceleration. Combination of magnetic and electric fields (deuterium or ion beam) produces magnetic field with cross drift across magnetic lines of force. Direction of drift and rotation along the helix depend on particle charge.



© Arthur W. Maas



MAGNETIC (plasma suggested by Frenkel and field used experimentally in K. R. F. That would have stronger ionizing fields at the center of the column. Many particles entering the column would be reflected into the column increasing the temperature and density of the plasma.

Concept in an induction-capacitance circuit. This substance is a function of rate of the column and the plasma. The balance between the confining gas, the pressure and the lateral pressure of the gas is always nearly equal.

The operating cycle begins with a period when the magnetic pressure dominates and reduces the diameter of the plasma cylinder. This increases the thermal energy of the gas and causes a thermonuclear reaction. Energy released by the fusion reaction increases the plasma diameter and pushes back the magnetic field, reducing a current in the coils and changing the capacitor capacitance. The electric power produced in the power could be much larger than the power needed to maintain the magnetic field, cause the gas, etc.

Preheated Plasma

This cycle is applicable to the case in which the plasma is preheated by a magnetically driven shock wave and accelerated through the longitudinal field by the coils around the cylinder. This technique would be similar to the methods in use at the Naval Research Laboratory and Aeronautics Research Laboratory described previously.

If the pinch discharge was used and stabilized by an external longitudinal magnetic field, the situation would be altered. In this case, the operating magnetic field would be caused by the lateral pressure of the gas plus the magnetic pressure of the external magnetic field, which would be the column force the plasma was created.

Regardless of the method used, if a plasma can be ionized in the point that a contained thermonuclear reaction is possible, then it certainly appears feasible to control and direct the force plasma to provide electric energy and thrust.

Numerous arrangements appear possible with magnetic fields that change with time, spacing a shock plasma containing its flow through a column, moving it with lower elements and accelerating it through it, thereby to provide large amounts of thrust and high specific impulse.

Along with these efforts to control a contained thermonuclear reaction, the pinch effect that have been widely reported the Russians have been working with the magnetically accelerated shock for at least two and a half years. The February issue of the Soviet publication, *The Journal of Experimental and Theoretical Physics*, contains a detailed article by A. I. Mironov entitled "The Acceleration of a Plasma by a Magnetic Field." This article had been submitted for publication in November, 1955.

Five basic tests are available on magnetically accelerated plasmas. Lyman Spitzer Jr., of Princeton University, J. G. Corbett of London University, England,

and Arthur K. Maas, of the Naval Research Laboratory, among others, have conducted advanced pinches. Using these refinements, it is possible to obtain a broader picture of some of the processes that are leading to the controlled thermonuclear reaction.

Two principal microstructural methods are used to describe the motion and the electrical conductivity of plasmas. One method is to consider each particle separately. The other, which is less laborious, is to consider the plasma as one continuous fluid.

The microscopic or single particle approach is often necessary in complicated situations and where very small amounts are required. The motion of single particles in electric and magnetic fields are partially illustrated on page 35. The electric field alone produces a constant acceleration on a particle which depends on its charge, mass and the strength of the field.

If a plasma particle is accelerated perpendicular to a magnetic field, the particle will rotate in a circle around a magnetic line of force with a radius that depends on its charge, the strength of the magnetic field, its mass and its velocity. If the particle is moving parallel to the field, its duration of motion is unchanged. Therefore, when the particle is moving at some intermediate angle to the magnetic field, its path will be a helix of constant pitch about a magnetic line of force.

Particles that will drift across magnetic lines of force if an electric field exists at an angle to the magnetic field or, if the strength of the magnetic field is not even, perpendicular to the direction of particle motion. Gyration around lines has the same effect as an electric field.

Microscopic equations for determining the plasma motion and its conductivity have been derived from the Boltzmann equation which are based on probability theory. A large number of simplifying assumptions were required.

Several papers have been written on problems involved in getting the answers given by the microscopic approach to agree with the macroscopic results. This is an unsolved problem, but it can't do not explain all of the phenomena which have been observed in plasma reactions.

Classical motion and current fluctuations, unexplained reasons as diffusion of the gas through the surrounding magnetic fields and very large radiation losses appear under some conditions to cut the plasma and prevent the attainment of thermal equilibrium.

Many experiments believe that these effects are due to electron or positive ion modifications and they are presently working to verify one of a number of theories that have been postulated

Defense Department Space Technology

Defense Department plans to move from design to efforts in the field of space technology. The \$20 million allocated to the Advanced Research Projects Agency and the services for fiscal 1959 compares with \$20 million for fiscal 1958. Following are details presented in the House Appropriations Committee.

PROGRAMS DIRECTLY RELATING TO SPACE TECHNOLOGY

(Control by Advanced Research Projects Agency)

(\$60 million)

	FY 1958	FY 1959
Project A-1 Space Probe and Satellite	11,250	11,250
The Vanguard Series Probes	10,000	22,500
Space Probe Launcher	500	
Space Technology (including funds for military threat region and Satellite Data of ARPA)	2,200	19,500
Communications Satellite	61,200	52,500
Arctic Area Satellite	200	400
Navigation (including satellite tracking)	20,200	2,500
Explores	5,500	
Advanced Projects Research	2,200	4,400
Space Flight Development	2,670	
Group of Engineers Satellite Mapping	1,000	100
Total	112,520	220,750

PROGRAMS FOR FURTHER DEVELOPMENT

WITH THE AIR FORCE

POSSIBLE APPLICATION TO SPACE TECHNOLOGY

	FY 1958	FY 1959
Highspeed High Program	41,200	32,500
Explores, Earth Probe, etc.	34,100	87,000
Communications, Guidance, Control, Surveillance	17,800	34,500
Research from	2,400	9,700
Research in Systems, Air Control, Navigation	2,200	14,100
Communications and Electronics	2,700	5,500
Research in Area of Research, Space Control, High Acceleration Effects	1,000	6,200
Robot Ability, Research Space Jet Development	10,500	30,400
Astronauts		
Physics, Space Research, High Altitude Experiments and Research	30,100	32,500
Research, Control, Key Research	16,670	33,000
Total	161,400	260,100
Grand Total	273,920	480,850

*Military Atomic and Anti-Ballistic Missile Work Not Included

about the origin and character of these disturbances.

Other experiments apparently are making a more basic study and are trying to use a number of different and complex methods to determine the plasma and create a stable sustained thermonuclear reaction for a few thousandths of a second so that useful power can be obtained.

The question, therefore, of the plasma production in such energy is to control the fusion of deuterium, at around 500,000,000°C. This is much lower than the 75,000,000°C as most that is needed for deuterium deuterium fusion.

The induction from the thermionic cathode reactor probably will require a great deal of energy in a form not of nuclear power. It will be radiated in large quantities at temperatures near toward the reaction point. A dual of sections will be related as the deuterium

and tritium ions fuse to form helium and a neutron.

One of the primary needs for more advanced controlled thermonuclear research is more powerful test setups to investigate and accelerate the plasma to the highest temperatures. Very large systems are available in Russia, the English are building larger equipment than they showed at Harwell at the first. In the years and months of construction, power tubes and other experimental equipment are in use in France and Sweden. Most of the apparatus is at least on a par with the devices the Atomic Energy Commission has installed to be in use by Project Sherwood, the U.S. controlled thermonuclear reaction program. While Project Sherwood probably has more available power than any of the other Western nations has working on controlled fusion, the foreign effort is considerable. Many U.S. and foreign scientists are studying their close cooperation between various national groups be allowed



UPPER launch mount for USAF Douglas Thor ICBM is hoisted into position prior to interconnection of the missile transporter.

Support Items Total 87% of Thor Cost

By Richard Sweeney

Los Angeles—Thor intermediate range ballistic missile ground support equipment—the facilities and hardware required to ensure a successful mission—was designed to meet these requirements:

- Reaction time which has to be less than the time required for an enemy missile to be in the Thor site from the enemy target area.
- Capability for strategic mobility in the fullest sense of the word.
- Automation, so valuable that even a only a checker in the system.
- Operational techniques and procedures which complement these factors, which are on a 24 hr-a-day shift status year in and year out, yet ensure that personnel constantly alerted for action do not go idle, become inactivated or allow their responsibilities to erode over time.

In the Thor weapon system, more than 200 units of support equipment are involved in ensuring the mission capabilities. These items represent 87% of the weapon system cost and upon firing must equal between the 30,000 lb. launch, recovery and missile transporter-cradle.

General support equipment ranges from the manually operated vehicle for the automatic IBM 705 computer. These specialized ground support equipment is located in three areas—main, where the warheads are stored

MISSILE ENGINEERING



Panel detector plate is visible in photo (left) of Thor ICBM upper launch mount. Photo at right shows the missile transporter which is used in the main platform. Transporter is positioned from the launching mount to erect the ballistic missile in firing position.

and handled, receipt, inspection and maintenance (RIM) building, and launch employment.

USAF's Ballistic Missile Division of Air Research and Development Command in Thor weapon system manager. The contractor keeps his three units in, particularly:

- Douglas Aircraft Co., aircraft contractor, also responsible for technical integrity of the entire weapon system, i.e., compatibility of all elements from the launch light bulb on a test panel to the missile and its transporter-launcher. Douglas also handles development flight testing.

• AC Spaulding, guidance contractor, has contract for guidance system and all equipment and associated items required for ground support and checkout of guidance system.

• General Electric (Philadelphia) is one of the contractors responsible for the assembly of nose cone structure and related, specific and items of nose cone launch equipment plus all associated systems and equipment necessary for accurate and checkout of complete nose cone.

• Radioelectric, responsible for the propulsion system itself and overflight facility to monitor and check on the propulsion system on the ground.

Douglas plays the predominant part in overall integration of weapon system's ground support equipment, in ad-

daption to the airborne and firing hardware.

That was designed as a strategically mobile weapon system (it can be packed up, carried, set up and operated almost anywhere).

It relies on an outside help beyond its own ground service equipment and crew, most delivered to operations.

All elements were designed to be air transportable, everything is on wheels, and the "system approach" was carried through to each detail in the area on the launcher, correct transporter being standard USAF stock item.

Various elements of Thor ground support equipment are not intended to be operated while on wheels, instead they rest on built-in jacks or specially designed legs. But in all cases, where they can be assembled quickly and equipment returned to transportable status.

Douglas ground perimeter specifications in construction associated with ground support equipment were such that all parts were designed for the widest possible latitude of capability, to ensure flexibility and to keep weapon system operators minimum time in hardware capabilities to the absolute minimum.

Early weapon system design is based on a modular concept.

In all cases, Douglas' ground specifications to contractors designing and fabricating ground equipment (ranged

with proven techniques, kept goals attainable within the present state of development to get desired reliability and quick reaction time. Additional Douglas considerations were such factors as weather, with Thor due to operate in Arctic and desert climates, plus reliability and long life costs including personnel and housing as well as missile purchase and upkeep.

Major ground support equipment suppliers in addition to Douglas itself, include:

- General Electric, power distribution equipment and controls.
- General Motors, power supply generator engine.
- Ford Motor Co., trailer shell fabrication (Douglas installs equipment).
- General Motors, liquid oxygen tanks.
- North Electric, automatic control equipment.
- Ford Machinery Corp., launcher base, transporter-cradle and ballistic power guide.
- Packard Bell and Auckin, electrical and electronic checkout and firing equipment.

For operation manual, according to various published statements made by officials, it averages per squadron. A good look at model being shown (which at that time represents those controls for these missiles at a base, per launch employment).

Consideration of the destruction



TRANSPORTER and hydrocradle supported unit lifted into air at their prelaunch position.



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LAWHOR control trailer contains command and monitoring consoles.



Electrical equipment trailer is to be checked.

available through one Thor squadron, the normal operating range of the water mobile range ballistic missile, plus the time requirement for nuclear in case of start of hostilities, all indicate that there are no "spares" as thought of in connection with airplane squadron spaces. A unit goes with what is on the launcher and is operational when the need arises.

Maximum Mobility

In line with strategic mobility requirements, a Thor squadron is designed to operate from a minimum of fixed facilities. One readily fixed facility is the receipt, inspection and maintenance building, which is closely related to a parent day depot hangar. However, a great deal of Thor maintenance can be done at the launch emplacement and, under any circumstances required for a Thor squadron could be done in place, in time a squadron emplaceable would require without the fixed facility and equipment of the RLM building.

A conception of the degree of system integration accomplished for Thor can be gained from the fact that there are about 1,000,000 lb. of wire, cable and tube involved in one squadron's operations. All this must be assembled quickly near the destination, with the benefit of engineers for trouble shooting in assembly and test of the ground support equipment.

Although a Thor squadron would be expected to have a shelter for the RLM building available, other elements such as fuel and oxidizer tanks are in transportation which and the assembly of support equipment is in trailers. Two major reasons for this are to reduce amount of facility construction required to operate, and to solve the problem of shipping and assembling various complex components of ground support equipment.

Six major trailers involved in Thor ground support operations are:

- Launch control trailer.
- Power distribution trailer.
- Electrical equipment trailer.
- Missile checkout trailer.
- Hydro-pneumatic trailer.
- Supplementary checkout trailer.

Trailers are standard—the same size Douglas used and become thoroughly familiar with in the Nike program. They measure 10x25 ft.

Launch control trailer houses the launch control officer and his master control panel, plus those consoles for monitoring the three missiles launched per launch control trailer.

In the launch control trailer there are more than 700 sq. ft. of wire, some five 200 lights and only 100 sq. ft. of floor space. In the center, a console is used throughout. Thor ground support equipment.

Launch control officer at his panel can stop a launch up to within one half second before missile is released, thus saving the last time in which a man can react to stop the flight.

In this trailer is equipment from all four major contractors involved in Thor program.

System Compatibility

Douglas has the responsibility to see that each contractor's contribution to the trailer's equipment is compatible with the whole, that the entire assembly complements and enhances each's ability as a checker, and that nothing is included which would require special

effort or detect from the overall efficiency of the trailer as a unit.

Power distribution trailer houses the 1,200 kw. required for the three missiles launched from each launch control trailer.

Electrical Equipment

Electrical equipment trailer has panels associated with the wire runs, voltage, propulsion system, guidance system, target programming and other elements involved in a mission. For part of a launch cycle the trailer is made an orbit and assembled, and functions are tested by remote control to launch control trailer at the proper time.

Missile checkout trailer is just what its name implies. It is used for checking subsystems and components functions, and is used normally in maintenance work.

Supplementary checkout trailer, called SCOT, has a computer programmed as a "perfect missile," and acts as a computer. In use, it is plugged in between the normal missile checkout trailer and the missile itself for comparison as to whether the missile is right at the missile checkout trailer or right.

Water mobile checkout trailer, or SCOT, is involved in a launch coast down, not do this come into play in the maintenance cycle outdoors, although this can be simulated with a remote on the launch pad.

If a missile has a malfunction during coastdown, (AW May 5, p. 64) its general area is indicated according to the stage of the mission.

Here the missile checkout trailer can be brought into play, and a remote source man can go out and work on the missile on the base of information



HSTF production prototype missile transporter for Thor is loaded into a Douglas C-124.



HYDRAULIC power unit supplies power for erecting Thor and for moving mobile launcher.

gated by loading the trailer to the missile. Subversion problems can be isolated and sequenced later.

Should such procedure be indicated, the SCDF can be utilized from its normal REM building facilities and plugged in to compare the missile and the missile checkout trailer.

Modular Design

For maintenance on the pad, repair area have a certain number and type of spare parts on hand or are ready for common other areas needed. Under Thor modular design, repairs probably fall the favor of employing a part component or perhaps even subunit, where trouble is indicated and replacing with a new part.

In ballistic missiles, a new system of maintenance has come into being. Where formerly, there were maintenance levels of operational unit, field

and depot, in missiles this has been abbreviated to operational and depot.

USAF personnel handle operational maintenance and contractor performs depot level work.

Ballistic missile weapon system contracts include provision for the contractor supplying all maintenance on his product, including what type missile stage are best accomplished where, how it is best done and at what time intervals. Data also are provided in spare parts type and associated level plus where those parts should be stored and handled and, as indicated, whether parts cannot break repair, depot overhaul, replacement or scrapping in favor of a new production item.

During the coming summer months, the Thor test program will include testing of operational hardware for reliability. Items such as the launching pad will be checked to insure every missile

can be fired before a part becomes unsuitable.

Because of the new roles people were to play in the Thor weapon system, a qualitative personnel requirements inventory program was indicated early. This program ties together people, duty station and the hardware so that when the weapon system is delivered to an operational unit, it can be put into immediate operational use.

Qualitative personnel requirements estimates (AW July 32, 1957, p. 79), identifies and clarifies, as early as possible, personnel personnel and training problems areas which might arise and tend to limit the effectiveness of the weapon system.

Efficiency Is Goal

In addition to this work, QPRF seeks to establish the best balance between maintenance and human effort in various parts of the weapon system in that full cost advantage is taken of the abilities of each. Simultaneously, feasible levels of mechanical and electronic complexity must be maintained; missile hardware must be accounted for, and the launch edge acquisition and retention characteristics of personnel must be considered.

Three factors must be considered in all functions of the ballistic missile system-on missile handling and launching as well as maintenance.

As QPRF studies its area in connection with a ballistic missile system, it may even come up with alternative plans for weapon system use based on human factors knowledge.

In the first few Thor ballistic missile operations, Grade 5 and 7 personnel will be used, but this is not assumed the final requirement.

Greater variety of technical effort in operations will be required in the RIM building, but presently it is anticipated that operations there will be no more difficult than the present comparable level and type maintenance operations for the B-57. An additional consideration, however, will be handling and use of rocket fuels and oxidizers.

Enriching the human parts of a ballistic missile weapon system to contribute the utmost of their capabilities to the proper functioning of the system will require, in addition to having them doing the right kind of job, giving them the right tools with which to work. An essential part of these tools is the technical manuals, the training manuals and other written matter which they must use to perform their proper function in the best manner.

Manuals for ballistic missile weapon system, beginning with Thor, will be based on new requirements rather than traditional format. Information will be complete as necessary, but will be presented in new ways. Classification and

sophistry are stressed, along with the proper distribution in exactly how to do the job, in a direct "to the numbers" procedure outlined in simple terms.

Work on manuals involved in ballistic missile program began in 1955. It was quickly realized that five major new goals were indicated:

- Content and format simplicity.
- Timeliness.
- Reliability and accuracy.
- Predictive feasibility.
- Integrated program.

Quantity and manner of presentation of information in manuals is tied to the needs of the operational user.

Manuals personnel will be highly specialized and limited, so that manuals should tell them everything they need to know about their job without any references elsewhere to any other source of information being required. Should a book be used away from a field facility (such as a workshop), it should be pocket size.

Timeliness Vital

Timeliness of information on ballistic missile especially that in use at the launch site must be absolutely up to date, and all the administrative support necessary to ensure this status must be applied.

Due to the elaborate requirements of the ballistic missile system, manual production cannot be run their natural course the same situation, it is all yours.

Where deviations from established production procedures for manuals is necessary to attain the foregoing goals, the production system for the manuals must be such that these goals are attainable. Although production must encompass the last four goals in the data on a task.

Ballistic missile manuals program already is integrated with various military commands and also is being coordinated with industry elements which must produce the data. Careful planning is required during the records and development phase to ensure smooth transition to full production phase and full operational capability within Strategic Air Command, the wing agency.

At present, some manuals for Thor will be by type:

- Depot maintenance, 31 x 11 in.
- Equipment oriented (hand), for RIM building, 31 x 11 in.
- Launch site, general WK, 31 x 11 in, job operations, 4 x 5 in., description of function, 4 x 5 in. These latter would apply to the various systems and sub-systems. The manuals and responses would see them in their launch site work and would need no additional reference material.

Significant difference between the previous manual approach, which was equipment oriented, to the new ballis-

tic missile, job-oriented approach, is the inclusion of the necessary elements from the large manual which are needed at the launch site, and presenting them in a format which will aid in getting the job done, rather than in the traditional manner which emphasizes the equipment.

As a sample of how the manuals effort is working can be seen in that present manuals are being developed and used on an interim basis. As changes occur they are checked against the actual hardware and equipment. Later on, when methods were developed, and these have been carried to one of the type between contractor plant and op-

erating base, will have one goal to the extent of ensuring self-sustaining directly on Mobilist plans.

To properly integrate information being generated by more than a dozen major contractors in different fields of specialization with their own production and administrative procedures located in widely separated parts of the country, control specifications were adopted based on existing military specifications and adopted by ballistic missile requirements. In the form of a contract exhibit, the specification was drafted and coordinated with the various USAF agencies interested in bettering technical methods.



MAIN section of Thor is hoisted from Douglas C-124 at Tinker AFB. Small wheeled dolly has hydraulic spreader and controls on the trailer to provide for clearance in loading.





Budd

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PART: Afterburner Nozzle Assembly, J57-T35 Engine

CUSTOMER: Pratt and Whitney Aircraft

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Bear Pairing Nimonic 75 (PWA670)
Cooling Duct—AMS 5524
Baffle AMS 5521

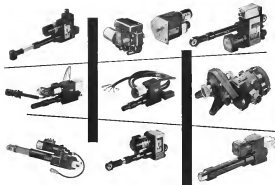
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Army Group Fires Redstone At End of Training Program

Army's 48th Field Artillery Missile Group prepares to fire its first Redstone XSM-14 sub-rocket range ballistic missile at Cape Canaveral, Fla. Troops from Battery A of the 48th Group have been receiving training at the Missile Test Center for almost a year. Above, technicians work on the third chamber during late rental checkout. Redstone's rated thrust is 75,000 lb. At right, top, a 62 ft. Redstone is lifted into a vertical position by an erecting crane. The gusty evening breeze is in the background. Below, the missile is guided into position. The weapon will be suspended above the launch pad, then lowered into place. Redstone's range is 200 mi. Missile has an inertial guidance system.



Above, the 62 ft. Redstone rises from the launch site after being hoisted by the 48th Field Artillery Missile Group. Launching was a guidance test for the Army unit.



Electric P.1B Mounts Firebreak In Tests

More than 1,000 test flights have been completed on English Electric P.1B supersonic fighter. Flight tests show bottom and side of large ventral fuel tank and ventral fin. Aircraft is armed with two de Havilland Firestreak infrared homing missiles mounted on launching rails below sharply swept wings. Ground support tower left releases optical strap to lift two Radio-Kayon Avion jet engine testpans upward, delivering noise and jet blast. At lower right, P.1B flies its first 30 min. Afterburner. An early test burn lasted about 1,117 mph.



AERONAUTICAL ENGINEERING

Lockheed Awaits Nuclear Airplane Order

By Robert L. Starfield

Marina, Ca.—Lockheed's Georgia Division, which only recently was acquired by USAF to submit design for a low level nuclear powered bomber, is geared to produce a nuclear airplane in about three years' time, assuming availability of powerplant.

Given the opportunity, the division "can put a schedule on it and a price on it . . . and can get going on very short notice," Aviation Week was told.

Anytime, anytime—at least as to light nuclear, before nuclear flight—would be thermally powered.

Performance of first powerplant can be estimated today, though more development is needed as its test and run situation.

General Electric Co. is currently developing advanced powerplant. Development has been at a steady pace, with no indications of "bottlenecks" in progress.

General Electric reportedly does not anticipate an increase in 1959 funding over 1958. Lack of additional funds could well negate new chances for development speedup.

Unbalanced Ratio

Unbalanced ratio—lack of development on nuclear while powerplant begins steadily ahead—could mean one of two things.

- Aircraft will not be ready when powerplant is available.
- Comb program will be initiated which increases risk and adds to expense.

Lockheed first entered the nuclear aircraft program in 1953, with award from USAF of a design study contract. But no funds have been forthcoming for hardware because of Administration cutbacks to curb atomic flight progress evaluated by USAF and Joint Congressional Atomic Energy Committee (AEC, May 17, p. 36).

In mid-October Georgia Division will begin operation of the new \$16 million Georgia Nuclear Laboratories Facility, which Lockheed leads and will operate for USAF as Air Force Plant No. 67, is located on a 35 sq. mi. tract at Decaturville, Ga.

Here the Lockheed plant will check effects of radiation on complete systems, materials and component parts of aircraft.

Facility for radiation effects work will contain several pressurized water 10 megawatt reactors, designed at the

Georgia Division and built by General Electric's San Jose branch.

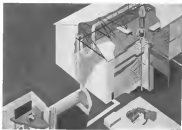
Date for first full scale testing is February, 1959.

Reactor, which uses fissionable fuel element, is located in center of 10,000 sq. ft. hall. Noemphs stand in handling pool, is cut as by double ion (10) which elevates it to ground level for radiation testing.

Small, light metal shell protects the 31 ft. high reactor from weather.

Big reactor will radiate into an open air shielded. Engine aircraft components, placed as up to in this case, will be tested along an open track that lead to the reactor. Results are evaluated in the radiation effects laboratory.

Facility will also do test work for air



GEORGIA Nuclear Laboratories' radiation effects facility reactor building



MAIN building at General Electric light engine test facility near Metro Park, Metro, is designed for ground testing a short air cycle motor propulsion plant which Lockheed may use in a nuclear airplane. Building is 320 ft. long, 254 ft. wide and 98 ft. high at crown. Building at right is for control and supporting equipment. At its right is two-story building for removing propulsion system heat. Site may be finished in two years.



FIAT G.91 has been called the only entry in NATO lightweight fighter competition to meet all military requirements.

Test Pilots Report on Fiat G.91 Design

By David A. Anderson

Gianni-Fiat official flight test reports on the Fiat G.91 lightweight strike fighter emphasize that transition to the plane should be easy, even for inexperienced pilots.

Extensive series of flights by con-

tinue and military test and check pilots of Italy, France, Germany, the United States and Turkey, have confirmed the best use of Fiat's engineering team to produce an atmosphere and easy-to-fly aircraft designed for a 150-mph ground attack mission.

Maneuvers and design were the result

of a NATO study and competition for a strike fighter able to operate off and on unprepared strips, capable of being flown by pilots with low jet time, cheap to buy and easy to maintain. Much in mania and criticism surrounded the competition, the competitive flight evaluations on final maneuvers, the report of the flight-test team, and the final selection of the Fiat G.91 as a first stage standard for NATO. But one test stands out: The Fiat design was the only competing airplane to meet every single military requirement.

Now at the first composite report on G.91 flight characteristics including data gathered from test pilot reports.

G.91 Screens
Planned military use of the G.91 envisions dispersed operations of the plane, operating out of grass-covered fields or unimproved runways. Flares would be strung against a specific target 150 m or less. Time consumed on the ground, including getting the engine started and having fuel sent to be kept to a minimum.

Pilots agree that the G.91 is easy to get into, banking up as simple and quick. Climb-invariant is well planned; all switches and controls are operated from within easy reach for a pilot of average size.

Shooting sequence is simple and quick, the cartridge starter gets the gun up to all rpm in about 40 sec, after the pilot initiates the start cycle. Idle power is enough to taxi or land

without an additional 1,000 rpm given enough surplus to make 90-deg turns easily on the ground. Brakes are effective and brake steering is good for small directional changes, additional power is unnecessary.

Lined up for takeoff, the pilot selects full flap deflection of 40 deg, then the stabilizer three and one-half degrees runc up, and again the thrust. Aerial outflow along brake release is about 6-14G. Brakes and outflow respond at about 50 lb, the nosewheel can be

lifted off at about 90 lb, and the plane backs ground at 100 lb.

At normal gross weight of 13,355 lb ground run on grass without external stores at 1,376 ft, with stores, the run is 2,518 ft. Ground run without flaps is about 2,200 ft.

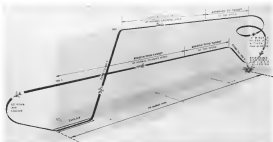
During takeoff and climbout long trimmed stability is large and positive right nose-up changes in trim, which can be easily handled, even when flaps are extended and as speed increases. Visibility is good in climbout.

About 70 sec after brake release, the G.91 will have reached its best climb speed of Mach 0.75 at about 1,000 ft.

Pilot holds this only for 1,500 ft, the cruise altitude specified for the mission.

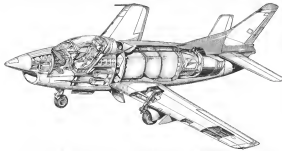
For a high-altitude profile the G.91 can climb to 25,000 ft in 7 min, 45 sec.

Most of the approach to target is made at normal cruise speed. For the reason, the pilot can hold thrust and the G.91 accelerates rapidly to about Mach



ITALIAN Fiat G.91 would be scrambled against a specific target 150 m or less. Landing base at target was a 10 m.

Characteristics and Performance			
	G.91	G.91 T (Developed)	
BASELINE DATA			
Wing span	ft	39.50	39.50
Length	ft	34.30	34.30
Height	ft	13.10	13.10
Gross wing area	sq ft	178.7	178.7
Wing area ratio (SAR) (wing chord)		20.5	20.5
WEIGHTS			
Empty weight	lb	4,320 (with stores)	4,550
Useful load	lb	4,750	4,750
Gross weight	lb	11,000 (approx.)	11,000
DESIGN			
Empty thrust	lb	4,500	4,500
Continuous thrust	lb	4,100	4,100
CHARACTERISTIC RATIOS			
Normal wing loading of takeoff	lb/sq ft	30	30
Thrust loading at takeoff	lb/hp	2.37	2.43
PERFORMANCE			
Max cruise level speed, clean	kt	600	560
Combat radius at low altitude	n mi	120	120
Endurance	hr	1.40	1.40
Max design Mach No		1.17	1.17



COCKPIT controls in Fiat G.91 are easily reached by average size pilot. Guns can be fired with fully speed brakes extended.

RECONNAISSANCE DATA PROCESSING

A new multi-phase program currently in progress at The Ramo-Woolbridge Corporation involves the development of an advanced system for the handling of reconnaissance information. This program provides several opportunities for engineers and scientists to research and development of systems and equipment for data display, processing, storage, and retrieval. Significant advances in the state-of-the-art will be required to meet the overall system specifications.

Inquiries should be addressed to
Dr. Wm. H. Harrison.

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PELLET-EXTRUDER now used for Douglas C-133 is only for Dow Chemical's automatic straightening. Section is 17 in. wide and 1.46 in. thick, including integral stiffeners.

Pellet Extrusions Used in C-133

Pellet extrusion method of forming aircraft structural shapes using ring sections after, produces high mechanical properties and weight savings, according to Dow Chemical Co.

Stress involves passing spherical magnesium pellets through pipes to extrude grain structure where metal is extruded into desired shape. Process was developed by Dow Chemical as air sponsorship of Materials Laboratory, Wright Air Development Center, USAF Air Research and Development Command.

Pellet extruded shapes were used in Douglas Aircraft Co. C-133 Hercules cargo transport. Total of 2,163 lb. of pellet extrusions were used in floor and structure, saving 50 lb. Compared with application was well suited to wide, uniform of increased compressive yield strength, since loading was primarily in compression.

Details of process were outlined in technical paper by George E. Jenson, Metallurgical Laboratories, Dow Chemical Co., Midland, Mich., and Hiram A. Johnson, of WADC, Dayton. Ohio. Process involved floor eight coats of 12 mesh and testing.

Pellets are spherical magnesium particles averaging .316 in. dia. and are produced in wheel atmosphere in natural gas atmosphere, Process includes:

- Melt of desired composition is prepared in non-aqueous solution and then pumped through steel pipes to heat and pellet (about 4000° F).
- Metal flows through orifice at core start rate and falls upon spinning disk. Centrifugal force disperses molten metal into droplets which solidify in

natural gas atmosphere, and fall to bottom of tank.

After screening through coarse mesh to remove stringy particles, pellets are packed in drums for shipment. Actual extrusion process, Jenson and Johnson said, is "relatively simple." Advantages are:

- Pellets are preheated and blown into extrusion press container and directly extruded into desired shape in short time.
- Process eliminates separate steps of precompression and extruding usually used in powder metallurgy.
- Pellet extrusions allow potential space advantage in large scale production by transfer of pellets to presses through pipes.
- Comparative yield strength equivalent is attributed to very small grain size of pellet extrusions.

Compressive Field

Impressively, yield strength of compression extrusions is substantially lower than the tensile yield strength because of twin ring that occurs when metal is compressed. As grain size is decreased, however, is increasingly reduced. Magnesium alloy, ZK60A (Mg-6Zn-0.69% Cu) was selected for commercial development because of combination of high strength and toughness. Jenson and Johnson explained.

Recently, the same composition, ZK60A (Mg + 5.5Zn + 0.6Zn)—has been used for room in production of high strength magnesium extrusions in conventional process. However, in casting cross-sectional area of the ex-

trusion substantially decreases the compressive yield strength of ZK60A-T5. Similar increase has no effect on extrusion made by pellet process.

For example, the maximum compressive yield strength of a 10 in. x 1 beam with a cross-sectional area of 4 sq. in. is increased 46% from 35,000 psi to 51,000 psi. Advantage of pellet extrusion of small shapes (cross-sectional area of less than 2 sq. in.) is less but still substantial. Jenson and Johnson said.

Engineers noted that ZK60A ingots must be "heavily worked by extrusion at high reduction in order to produce a uniform fine grained structure." If the shape is too large to permit adequate reduction, then workpiece the cast structure is not completely refined during extrusion and the compressive yield strength is substantially reduced.

Since ZK60A pellets have smaller grain size than ingots, only a low reduction is required to provide satisfactory welding into an extruded shape. Dow Chemical now has a 17,500 ton press operating on production basis at its Midland, Ill., plant. Conventional ZK60A-T5 extrusions with a maximum compressive yield strength of 35,000 psi are expected to achieve up to 5 sq. in.

Former and Johnson said larger shapes (up to 25 sq. in.) are possible, with 35,000 psi maximum compressive yield strength.

Mitsubishi Studying Super Tiger in U.S.

A team from Mitsubishi Heavy Industries is visiting General Motors Engineering Corp. to outline production plan for the 179 powered F-111F Super Tiger fighter to be built in Japan, pending final approval by the Japanese government of a detailed program and cost estimates.

Final program will also require approval of U.S. government. General Motors reports that Super Tiger production for Japan could start in 1979 and would require 300 aircraft to be built by the end of 1984, the majority of them made by Mitsubishi.

Boring Rolls Out 100th Jet Tanker at Renton

Boring Aircraft Co. has rolled out its 100th KC-135 Air Force jet tanker transport at Renton, Wash. Tanker of 145 KC-135s have been ordered. First production will reach 15 airplanes per month in July. Company and KC-135s have shown nearly 15,000 flight hours in prototype. Air Command assignments would start this year production, on Oct. 2, 1974, first KC-135 rolled out in July, 1974.



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SCIMITAR: leading configuration shows sharp leading edges, large flap area. Note speed brakes extended engine intakes (right).

Scimitar Entering Carrier Service

London-Victor: Supersonic Scimitar, incorporating a number of across-the-board changes, goes into Royal Navy squadron service this month with emphasis on nuclear strike capability.

Surprising Scimitar is first Royal Navy aircraft to have:

- All-hydraulic 1,000 psi. air-act.
- Fully powered control surfaces and power-assisted controls.
- Low pressure air starting unit, using

mobile gas turbo-compressor ground equipment.

• Expanded air flowing over flaps for reduction in takeoff distance and approach speed.

Scimitar is powered by two Rolls Royce Avon jet engines, from which an air bleed is taken over flaps for supercristation. (AVR Sept. 16, p. 16). Aircraft is four Miles 30 sea area, using radar gun sight ranging.

Wing span is 32 ft. 2 in. and length is 51 ft. 4 in.

Boundary layer control surfaces are bled from compressor stage of each engine and then ejected from a super sonic nozzle over the trailing edge flaps.

Wing tip stall which had led to marked pitchup tendencies and poor low-speed characteristics isolated series of aerodynamic changes. Tail plane was altered to give an additional setting, lowering tail tips about six feet into the wing wake.

To further reduce pitchup, new tooth leading edge was provided to contract forward movement of the center of pressure and reduce down wash on the tail planes. Divided, drooped leading edge was installed to counteract leading edge flow breakdown due to action of flaps. Outer nose flap deflects 30 deg. the inner 20 deg. Boundary layer is 1 in. high, runs for two-thirds of wing chord length.

Flaps are about 15 psi and achieve final approach speed to 110 kt. Area and angle of elev. breaks also has been increased. Hydraulic boost is available for roll and elevation.

Mobile compressor which supplies low pressure (150 psi, 200C) air to Rolls Royce turbo starter mounted at engine intake starting time of about 4 sec. Refueling under pressure but at lower ground time to 15 min.

Noise incidence

To reduce noise incidence, Scimitar was jet pipe extension leading into carrier mufflers for ground use. Device also reduces ground resonance effects in tail section.

Aircraft will be assigned to carrier HMS Victroler. Carrier will have pilot deflection installed behind catapults and lift-off will be sound-proofed. Scimitar approaching on shadows are to be reduced. Orders will be carrier based and probably will be Scimitar.

Flare has fitting for four external fuel tanks.



PRODUCTION model of Folland Mk.1 Gnat is converted in facts. Fighter, powered by Bristol Oryx 700 turbojet (4,550 lb. thrust), has delta-like nose cone containing radar, and two delta-like pods in dorsal spine for radio compass loop (left) and nose intake (right).

Avionic Changes Mark Production Gnat

Bumble, Hampshire-Avionic and woodruff modification mark late production models of Folland Aircraft Ltd.'s small Gnat Mk. 1 light fighter. Bristol improved navigation capabilities and flight characteristics in comparison with late models assigned to Ministry of Supply flight development program.

Production model, examined for late conduct these features:

- Delta-like nose cone, housing radar ranging equipment plus two delta-like pods in dorsal spine, which house radio compass loop and nose intake.
- Small wheels, running spacers on wheels, designed to prevent all-terrain "bump".
- Extension of nose-view windows, plus small area on intake of wing root which now on the Ministry of Supply aircraft.

Earlier production aircraft NK 719 and NK 740, shown with British mod-



GROUP tank above will be used on all production Folland Gnat. Tank is a conversion of an original Bristol 90 psi selector pneumatic tank. The standard metal section uses its capacity to 66 gals.



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POLLAND Coast KC-70, used by Ministry of Supply for flight development, is carrying over 500 lb. fuel tanks and two 60 gal. drop tanks. Tanks have jettisoned holddown to Mark I.



AAST of Pollard Coast can be worked from ground as fuel assembly at Hamilton, Thompson. Its roller assembly stages, engine front and engine fuselage are entered to jig for access.

ings are without sides and tail cone group have two rear-view windows and all of cockpit.

Boat Crest is designed to carry two 500 lb. bombs and Pollard 60 gal. drop tanks. Later, are modified 50 gal. Bristol selective plastic tanks and 50 test the aerodynamic qualities of the new shape. This eventually will be of all metal construction.

Two drop tanks, which give additional 1000 lb. endurance, are bolted together in the spread of a second. Fuel is transferred to main tanks by compressed air at three pounds per square inch. Empty weight of the small light aircraft is specified at 1,500 lb. Gross weight is 6,500 lb. Span is 28 ft. 1 in. Length is 29 ft. 8 in. Height is 7 ft. 7 in.

Crest is powered by Bristol Chryslers 751 turboprop with thrust of 6,510 lb. Speed is specified at Mach .90.

All major subassemblies of aircraft are constructed at Earlegh Airport, Southampton. Final assembly is at

Pollard's flexible plant in Hampshire. Small size and simplicity of Crest facilitates production. Subassemblies on rollers can be wheeled from one stage to the other almost any part of airplane can be machined from ground level. While in rig, front and outer fuselage can be tested by two men through any desired angle to expedite work.

WHAT'S NEW

Publications Received:

First Flight—In, Glenn Stewart—Webb Parnes Corp., 2 West 45 St., New York 36, N. Y. 45 54, 325 pp.

Detailed reports on flights which analyzed application of important technical innovations, and extension in the use of aircraft, civil and military.

The Midknight Chance—by James Leavitt—Pub. Royal & Co., 221 East

49th Street New York 17, N. Y. 54 00, 143 pp.

This book has set out the strange story of the evolution of the great vessel, the U.S. It brings out the political and social, and the buying in high places, which seems to characterize every new development in national growth.

Landing Gear Design—by J. G. Condon—Pub. the Macmillan Co., 60 Fifth Avenue, New York 11, N. Y. 512 00, 342 pp.

This book should meet the important needs of both aeronautical engineers and factories and the mechanical engineering in aircraft design with mechanical and structural engineering.

Strategic Air Command—by Richard G. Hebb—Pub. Dell, 350 W. 5th St., New York 14, N. Y. 54 58, 200 pp.

This book explains the important function, power and the increasing power of America's greatest military command, known as SAC.

Plant Engineering Practice—by editors of Plant Engineering—Pub. P. W. Dodge Corp. in cooperation with the Technical Publishing Co. 515 10, 67 pp.

Presently comprises of more than 100 experts in different fields all related to plant activity.

Reports Available

The following reports were sponsored by the Office of Technical Services, United States Department of Commerce, Washington 25, D. C.

The Stress Corrosion and Properties Research of Titanium and Titanium Alloys—by D. W. Smith, F. W. Fick and R. S. Frazier. Technical Report, National Bureau of Standards, for Office of Aeronautics Research of Defense Res. Research and Engineering. \$14, 10 pp., (PB 113515).

Feedback System Testing—by G. F. White, Naval Research Laboratory. \$10, 10 pp., (PB 113441).

Operational Requirements for NBC Equipment—by F. S. McLaughlin, Technical Report, Ordnance Corps, Ordnance Research Laboratory. \$10, 10 pp., (PB 113157).

Valentine Research GEC, Andrews Dept. W. P. Gahm, G. D. M. Fuchs, H. P. Coburn and D. H. Archer. Naval Research Laboratory. \$10, 50 pp., (PB 113156).

The Preparation of Highly Effective Fuel Cells—by R. S. Frazier. Technical Report, Naval U. S. Army Ordnance Corps. \$10, 10 pp., (PB 113151).

Jet Age Planning Program Report No. 1—by Civil Aeronautics Administration. \$10

Navy Contracts

Washington—Following is a list of indicated contracts for \$25,000 and over as released by Navy Contracting Office.

ALABAMA FLUORIDE SERVICE—The Fluoride Service, 1000 10th St., Mobile 10, Ala. 36601, 100 100.

Henry Corporation—Co. Henry Corp., 1000 10th St., Mobile 10, Ala. 36601, 100 100.

AT Spack—AT Spack, 1000 10th St., Mobile 10, Ala. 36601, 100 100.

BRITISH AIRWAYS—British Airways, 1000 10th St., Mobile 10, Ala. 36601, 100 100.

CHARLOTTE—Charlotte, 1000 10th St., Mobile 10, Ala. 36601, 100 100.

McKinnon Construction Co.—McKinnon Construction Co., 1000 10th St., Mobile 10, Ala. 36601, 100 100.

NAVY DEPARTMENT—Navy Department, 1000 10th St., Mobile 10, Ala. 36601, 100 100.

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Typical Stalker fabricating. Stalker assembly of aluminum alloy (Photo courtesy of Curtiss-Wright Corp.)

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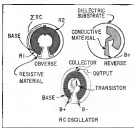
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INTEGRAL micro-circuitry, made by evaporative depositing points, may reduce volume, expense and weight by a factor of 100 or more, with improved reliability. In photo at left, experimental computer flip-flop circuit is on right. RC oscillator is on left. Oscillator (shown at right) is made by depositing abrupt lines of conducting material on both sides of ceramic disk, followed by selective sputter on one side. Resultant distributed constant network improves performance. Transistor circuitally may be done this way.



Electrochemistry May Cut Circuit Size

By Philip J. Klein

Washington—Electronic technology may be on the threshold of the most revolutionary change in its history, spurred by needs of space vehicles for miniaturized size, remote component capability of replacing operation for extended periods.

Military sponsored program now au-

dit is not to be limited as expected to results in techniques for manufacturing complete functional circuits as an integral unit using electrochemical processes aimed at the present practice of mounting discrete individual components which must then be interconnected into the desired circuit.

One such technique under develop-

ment deposits thin films of conducting, semiconductor and insulating material so that circuit elements are introduced during the fabrication process. There would be no soldered connections.

Many of the materials employed will be new, specifically synthesized to perform a desired function instead of deriving largely from materials found in nature.

No Pipe Dream

Micro-circuitry, an molecular circuitry as it sometimes is called, already has gone beyond the dream stage to a number of components and pre-formed lab. circuits, where complete functional circuits of modest complexity are being fabricated on a laboratory or model shop basis. For example:

• **Vern Instruments Co.** has produced variety of passive elements, flip-flops, d.c. amplifiers by evaporative depositing process, with only the transistor added as a separate component. Current work is sponsored by Office of Naval Research.

• **Army's Dismal Goodhouse** has laboratories for producing transistors and diodes by a special photo-etch process.

• **Bell Telephone Laboratories** and **Kodak Corp.** at America have developed complete discrete circuitry roughly the size of transistors, which perform same digital logic function that now re-

quires 30 transistors, 40 resistors and 10 capacitors (AIEE Nov. 4, 1957, p. 95, April 14, 1958, p. 71).

• **British's Royal Radar Establishment** is working on a four transistor flip-flop circuit which will require deposited circuit elements, have equivalent of an another follower output with lengths of high conductivity semiconductor to run emitter and collector elements. Emitters will measure 6 microns square, by 2 microns thick.

USAF Program

Major spending in industry efforts will come soon when Air Force begins awarding contracts for molecular circuitry developments which are expected to total more than \$1 million during coming fiscal year. These will be sponsored by Wright Air Development Command's Components Division and by Air Force Cambridge Research Center.

After exploratory visits and discussions with major research laboratories and a number of universities, Air Research and Development Command concludes that molecular circuitry is feasible and that considerable work is already underway, according to Col. H. L. Lewis, chief of Aeronautics Electronics Division, ARDC Headquarters.

One indication of vigorous interest is the fact that ARDC already has received more unsolicited industry proposals for molecular circuitry developments than it can support with available funds, according to Lewis.

Major Advantages

Molecular circuitry should make it possible to achieve equivalent of current packaging densities of between 18,000 and 100,000 per sq. in. to 100 to 1,000 times the accuracy obtainable today using conventional component and the best microfabrication techniques. August Stanton, president of Vaco products that use reflex ion-



Multiple Lague Unit

Monitors integrated circuit, Type 200C, consisting of 10 modules, for expansion and two transistors, which can be used as a complete flip-flop, plus provides for pre-amplifying, delay, shaping or delaying output, has been announced by Spence Electric Co. Completely computerized unit measuring 1 x 1 1/2 in. is, has one compartment leads. For applications data, write for Engineering Bulletin 6712, Spence's address: 127 Marshall St., North Adams, Mass.

ponents per cubic inch may even be possible. There should also be some possible reduction in weight.

Even more important than the size and weight gains is the vastly improved reliability which is expected from molecular circuitry. Today, average equipment which can operate for 100 to 1 as a military aircraft without maintenance or malfunctions is considered a reliable piece of equipment. But for a military vehicle, 10,000 to 100,000 hours of trouble-free operation (approximately 11 months) is an automatic goal.

By eliminating most component interconnections and related parts, a circuit's reliability is expected to boost sharply. Even more important, the inherent cleanliness of the processes used to fabricate molecular circuitry is expected to greatly reduce impurities contaminating. In the evaporative deposition process, used by Vaco and Servotronics, laboratory tubes

place under high vacuum at elevated temperatures. The "boiling" of the working material, like distillation, makes it possible to separate out unwanted impurities. In the material techniques similar to those employed in mass spectrometers also can be used to screen out undesirable impurities.

Developmental Timetable

Initial use of molecular circuitry, probably will consist of such devices as digital computers, instrumentation, communications receivers where power levels are low and the resulting size weight reduction and improved reliability are greatly needed for space vehicles and missiles.

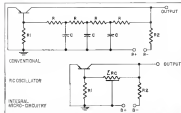
Within five-year molecular circuitry will be in limited use in such applications, possibly also as pilotless aircraft. Within 10 years molecular circuitry may be almost as commonplace as solid state components in today's electronic systems.

The new techniques are also seen to extend to solid state industrial and consumer electronic products where miniaturization, size, weight and high reliability offer advantages. Some molecular circuitry enthusiasts believe that it will greatly reduce costs and that this will assure its widespread use for consumer products.

Lower Costs

Considerable capital investment will be required for the processes outlined to produce molecular circuitry and to provide automation of the process for good quality control. Even allowing for the higher initial investment, proponents of molecular circuitry say that there should be a net saving in view of the considerable reduction in direct labor costs.

An equally important saving, particularly in short run production, will be the use of changing circuits produced by a machine, with reduction in setup



CONVENTIONAL circuitry (top) uses larger components in comparison with integrated version, using distributed elements, produced by Vern Instruments Co.'s vacuum depositing process. Office of Naval Research is sponsoring this phase of Vaco's work.



MINI-MODULES (left), manufactured through a new ultraminiaturization technique being developed by Radio Corp. of America, are expected to achieve size and weight of current equipment by 90%, providing ultrahigh efficiency of 300 to 400 components per cubic inch. Modules consist of stack of 0.1 in. sq. sub-modules, each of which is built up from five ceramic plates (epox), each containing one or more components with dot-former which have been fabricated directly on plate wherever possible. This facilitates such components as transistors, capacitors, resistors and inductors. RCA is developing mini-modules under \$5 million Army Signal Corps contract.

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and personnel training time from gyro units, levels. Among machines are controlled by magnetic or pneumatic tape, it should be necessary only to change the tape program and set static new working materials, seconding to some molecular structure tape.

Industry Impact

Molecular crystals may speed high-speed lines of demarcation between electronic component and equipment manufacturers. Because molecular crystals pose a direct threat to current metal parts, it is logical to expect component manufacturers to move to protect their position. However, molecular crystals development will require much more research and know-how than study of the smaller component manufacturers' use, says parent.

Smaller component manufacturers also will be handicapped because molecular crystals seek to produce functional metals rather than merely to reproduce, coating, conducting or insulating. One possible use is in manufacturing process. Then the description of molecular crystals also requires considerable knowledge of electronic structure and its function in the equipment in which it will be used.

Equipment and circuit designers long accustomed to working with groups of interconnected components also will need to take a fresh approach—some times with latitudes built.

For example, in many types of filter networks, better performance could be obtained if the network were constructed of an infinitely large number of components distributed randomly. But this is too crude with discrete components and so the designer can protect performance and settle for a network consisting of the fewest elements (lumped constants).

Vaco Manufacturing Co., one of the molecular crystals pioneers, finds that it is actually easier to produce a set of some with distributed constants than one with lumped constants with good improvement in received performance, according to Jack G. Smith, vice president engineering. But to do so requires that Vaco's design engineers who are circuit designers work along side fabrication process designers.

Vaco Microcircuitry

Vaco, manufacturer of precision free gyro, power supplies and other electronic equipment, first began thinking about fundamentally new techniques of manufacturing about five years ago. Of course now to come up with a new approach which would cut the cost and manufacturing problems involved in small components that are produced. About two years ago Vaco began to investigate evaporative depositing tech-



VACO-TUNED radio and ultrasonic frequency transducer at top is made by depositing process. Conventional unit is at bottom.

niques which appeared to be the most promising idea to meet out of their manufacturing efforts.

Office of Naval Research took over sponsorship about a year ago as part of its Atomic-Navy Interconnection Program (ANIP) which is developing an integrated method of manufacturing (including TV tubes). Program requires use of an infinite digital computer and the Vaco techniques showed promise of more rate and weight reduction in the light of greater reliability.

Under the ANIP program, Vaco is working closely with scientists of Servo Mechanisms, Inc., who are conducting research in new materials for possible use in hybrid or even completely depositing process. Several of these processes have extremely high temperature components (AW Sept. 30, 1957, p. 70).

Molecular Metallurgy

In the evaporative depositing process the working material is heated (usually by electron bombardment) to its vaporization temperature in a high vacuum chamber. The process vapor then is deposited in a thin film on suitable substrate (metal) material. Thickness of the thin film can be controlled by choice of substrate material and/or its vaporization temperature.

Shape of film deposited on substrate can be controlled by placing a mask of the desired shape between vapor source and substrate. Another possibility, commonly under investigation by Vaco, is to change vapor particles, then use magnetic fields to deflect or ion beams to trace out the desired pattern on substrate, not unlike deflection technique used in TV tubes.

Vaco reports that it has developed techniques which make it possible to simultaneously evaporate several different types of material and mix and deposit them in controlled proportions. The "molecular metallurgy," as Vaco

says, it permits the alloying of materials with widely different vaporization temperatures—something that is impossible by conventional metallurgical techniques.

The ability to create new materials by molecular metallurgy opens the way to producing thin films of sensitive materials with lower or non-linear characteristics which can vary as the independent of temperature. Films can be produced with a variety of different magnetic characteristics.

Progress at Vaco and Servo-mechanisms in producing semiconductor devices by evaporative depositing process suggests that it is only a matter of time before field-effect transistors can also be manufactured by this process.

Vaco's Progress

In the course of Vaco's CONKegan used program, the company has produced a number of interesting examples of what it calls "integrated microcircuitry." Vaco explains that it has not attempted to achieve maximum possible size and weight reduction at this stage of the development. Despite this, reduction of better than 20:1 in early achieved, compared with good substrate size requirements.

For example, an Electro-Optical Flip-Flop circuit of conventional design uses two transistors, five capacitors and seven 100K resistors. Volume of two of these resistors is roughly the same as the volume of the complete circuit when produced by Vaco's new technique (0.018 cu in.) Of this total, the two transistors occupy about two thirds the volume of the integrated microcircuit.

A carrier generator (GIC oscillator), which originally consisted of eight resistors, six capacitors and a subminiature tube enclosed in a bonded-on circuit can now be reproduced by Vaco using distributed constants. This is improved performance of the circuit that a transistor could be substituted for the original tube. Entire oscillator now including transistors, occupies only 0.015 cu in. in integrated microcircuit form.

Significant reduction in size and weight plus improved performance by Vaco's use of thin circuit results from Vaco's ability to combine functions of resistors and capacitors.

For example, to produce a simple network of series resistors with about 200 resistors, Vaco deposits a thin conductive film on one side of a ceramic base (substrate) producing equivalent of one capacitor plate. On opposite side of substrate a thin film of sensitive (highly conducting) material is deposited so its pattern resembles with that of conductive film on reverse side. Separation between two films is thereby distributed along the length of resistive element, producing the effect of a nearly infinite

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Interested? Write or call Manager, Special Products, Missile Division, North American Aviation, 13214 Lakeridge Blvd., Downey, Calif.

MISSILE DIVISION

North American Aviation, Inc.



YACOM chamber might be used for tape automated fabrication of micro-circuitry by evaporative deposition.

series of reactions with evaporation is absent.

In the case of the RC oscillators, the subcircuit is connected in series with two other resistors (R1, R2) which serve as transducer base resistor and output resistor.

Instead of fabricating R1 and R2 as separate elements and then connecting them to the terminals of the series resistor network, Vaco simply etch-plates the deposited resistive film beyond the ends of the evaporator film (on the reverse side). Metal tube are initially deposited on the substrate to provide terminals for connecting R1 and R2 to oscillator output and transducer line.

To achieve full potentialities of the Vaco process, it frequently is necessary to modify a circuit designed for conventional construction techniques. This requires some initial adjustment in circuit designer thinking and familiarity with the new process, but is not difficult Vaco says. Company currently is writing a handbook, which will aid circuit designers in applying new techniques.

This type of construction, to lack of fractional cents instead of a collection of components, is not limited to Vaco. Wright Air Development Center's Electronic Component Laboratory soon will award contracts for "tech bids" at the possible application of radically different approaches to performing basic avionics circuit functions. One WADC program, for example, will call for study at a variety of the most recent state-of-the-art discovered de-

five-hundred hours of continuous pressure measurement at 600° F

Two output CEC Pressure Pickups, the 4-316A and 4-317, now combine to offer a wide range of pressure measurements at extremely high temperatures. Designed for continuous operation at 600° F without cooling, both pickups operate on the unbonded strain-gage principle. Together they cover a pressure range of 15 to 3000 psi. The 4-316A is also available in differential (to ± 25 psi) and unidirectional differential models (to 150 psi). One-piece construction of diaphragm and case—machined from 416 stainless steel—ensures that no foreign substances will come in contact with the measured media. Sizes are 1/2" and 1" nominal diameters for the 4-317 and 4-316, respectively—weights, 25 and 23 grams with mounting flanges. These fixtures provide rugged, stable pickups for static and dynamic high-speed testing, engine studies, and supercritical tests where external cooling is not practical. For other applications, a special cooling adapter extends the operating range of the 4-317 to 2000° F. Call your nearest CEC sales and service office for additional information, or write for Bulletin CEC 1568-XH and 1568-XJ.



BOTH FIGURES ARE SHOWING AROUND SLICE



to 5000 psi

to 600° F

Transducer Division

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Drone Control Station

During test flight tests, Sperry Gyroscope Co. engineers check performance of major ground control station for its Mission Command Guidance System located inside an inoperable tank. Drone is controlled from position at left of controls in bank of light instruments while flight is monitored from right position. Flight path is traced automatically on plotting board.

side signals are of three can be applied to control aircraft. This includes such things as the Hall Effect, Servo Effect, Electromagnetic Effect, Servo Effect and pneumatic transducer, to cite only a few.

Another approaching WADC program will seek the development of a direct-acting solid-state components that are capable of acting as transducer or performing complex logical operations.

The transistor has radically changed the structure and electronics art in the 16 years since it was developed. New concepts of producing devices capable of performing complex exact functions and new techniques for fabricating integral circuits by electro-chemical processes could have as great a greater impact in the next decade.

Collins Radio Builds Lightplane Avionics

Collins Radio, Inc.—Collins Radio has entered the lightplane avionics field with integrated line of lightweight, rugged, cost-effective "value quality" communications/navigation equipment which will complement company's new line of light aircraft in-line equipment for small twin-engine business aircraft and subsonic. Collins new lightplane equipment complies with Civil Aviation Administration technical standard and meets new Federal Communications Commission requirements.

Typical integrated package for single-

engine lightplane now consists of:

- VHF receiver 51K-1, designed for panel mounting, provides 90 separate channels in frequency band of 118.1-138.9 mc., with surface-type digital channel selection. New crystal-controlled receiver weighs 51 lb., is priced at approximately \$675.

- VHF transmitter 17L-5 also for panel mounting, provides 90 separate channels in same 118.1-138.9 mc. band, is rated 5 watts output, provides digital

channel selection. Unit weighs 18 lb., is priced at approximately \$185.

- Power supply, modulation, IF and audio amplifier for VHF receiver, type 42TB-2, weighs 5 lb., is priced at \$155.

- Omni/Incline communication indicator 144D-1 provides 3-in. semi-circular cockpit display of aircraft bearing which has omni/incline beam. Device weighs 24 lb., is priced at approximately \$1,340.

When located instrument up speech capability is desired, lightplane operator can add dual equipment pack.

- Mobile beacon receiver, 51Z-2, weighs 12 lb., comes in short 1-ATK size now, is priced at approximately \$705.

Collins says it has tentative plans to furnish complete avionics package which may include custom-tailored racks for equipment mounting.



• Voluntary Family Class—Number of private equipment manufacturers have voluntarily offered to accept schedule priority orders as late as Air Force contracts in anticipation of proposed Defense Department policy to include reliability provisions in future government contracts.

• Air Force Storage to SSB—Air Force flight tests on new Collins AN/ARC 55 airborne single sideband transmitter-receiver and Radio Corporation of America's ARC-61 bracketed version of RCAs ARC-121 have proven to succeed that Air Force alone speech units from present AM to new up (periodic) SSB. Collins ARC 55s have been ordered for use in new Boeing



Collins Radio lightplane equipment consists of 1-VHF transmitter-2-VHF receiver, 3-transmission indicator, 4-power supply, modulation IF, audio amplifier, 5-mobile beacon receiver. Collins says equipment complies with GAA standards, FCC requirements.



FIRST SIKORSKY S-62 amphibious helicopter is powered by a single General Electric T55 gas turbine engine rated at 1,000 hp.

S-62 Slated for Full Production in 1961

By Edwin J. Holton

Stafford, Conn.-Sikorsky Aircraft expects to have its last, full-scale production S-62 in 1961 at a price of approximately \$215,000 (\$200,000 depending on whether customers want either a General Electric T55 or Lycoming T53 turbo-shaft engine).

Company states that it could have the S-62 available for delivery next year without delay, but only if the full-scale production at that time would require higher price.

However, it is unlikely that civilian models would be available at this earlier date, since time required for Civil Aviation Administration certification is not expected to make possible 1959 civilian deliveries. First prototype only started its emergency flight test program in past few weeks.

A wide market is anticipated by Sikorsky for the new S-62 because in addition to turbine performance and use of three proven S-55 dynamic components (AWF fus. 30 p. 96), the helicopter basic design lends itself well, usually, to a wide range of customer requirements. Thus one of the company's previous models, Sikorsky's experience report that the S-62 already

has received more worldwide orders from potential customers than any previous project. Sikorsky Sales Manager J. S. Higgins says that he anticipates production of at least 1,000 S-62s.

Customers will have a choice of two basic models, the amphibious version now being or a land type. Since the landing gear and outrigger floats (retractable) will be common to both, wheel track landing gear. Before version will be available with General Electric T55 or Lycoming T53 turbo-shaft engine. The land version, a specially designed for air transportability. Two S-62 land versions could be carried simultaneously in a Douglas C-119, with conversion from flight land to landing taking one hour. Features include folding rotor blades, retracting the tail rotor and retracting the landing gear which by applying shock absorbers give strain, providing two-foot maximum vertical clearance on the C-119's nose landing ramp.

Amphibious Hull

Amphibious model, capable of land water or air operations, has hull designed to take right foot/outrigger contact with surface. Landing gear is hydraulically retractable two position type.

Sikorsky anticipates major interest in the new design from current S-55 operators since the S-62 is basically a replacement for this model. Company plans to provide S-55 owners with a modern program whereby they could have in their current equipment for the new model with the manufacturer giving them credit of approximately \$60,000 (\$65,000 for the S-55 dynamic components). Sikorsky would accept the old hull.

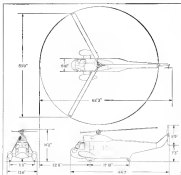
Ability of operators to utilize current supplies of S-55 dynamic com-



Y-BOTTOM of land version is designed to cushion impact when landing on water. It also directs spray outward and down. Floats lower landing gear and assist parking and sailing.



THREE fixed-wheel land version of Sikorsky S-62 would be designed for air transportability.



BASIC S-62 design could be changed by adding fourth rotor blade creating four-component.



SIKORSKY S-62 interior is designed to accommodate 10-12 passengers.



COCKPIT of Sikorsky S-62 is shown above. Helicopter appears to handle as easily on the water as on land, pilots have made light turns and can enter S-62 in its own length.

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engineer searching
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engines of 2,000 hp each. Fuel capacity is 1,350 gal. Airplane has gross weight of 12,200 lb., empty weight is 18,000 lb. Weight breakdown shows that 6,000 lb. are available for payload, baggage and optional equipment.

Performance data supplied by the contractor company, with Crusader at 12,200 lb. gross weight, includes: cruise speed at sea level (M10) power 323 mph, cruise speed at 10,000 ft. (55% power) 280 mph, stall speed (gross and flap up) 78 mph, stall speed (gross and flap down) 69 mph, single engine minimum control speed (gross and flap up) 95 mph, stall speed (gross and flap down) 106 mph, maximum rate of climb (M10) power 1,880 fpm, single-engine rate of climb (gross and flap up) 450 fpm.

Contractor has been given Civil Aeronautics Administration Supplemental Type Certificate #181.

PRIVATE LINES

A new four-engine low-wing all metal business plane with broad flexible loading gear, aimed at a replacement for the high-wing T-107, is on the drawing boards at Piper Aircraft Corp., Rock Haver, Pa. New airplane is not expected to be available at least until 1982. Company is hoping to keep price at about \$10,000.

Demonstration loss to acquire businessman and pilot with new Lockheed JetStar will be made to meet U.S. intent to join with the number two prototype (flight evaluation by American West, Nov. 5, p. 28-90).

De Havilland Canada Otter airplanes are now being delivered to N.Y. State Commission Authority, which will have plans, fitted with special load equipment, for use in firefighting in remote forest areas. Plans will also carry firefighters to forest fires.

Four-place Jodel Monoplane D 140 (two-light engine) powered by a 160-hp Lycoming, is being ordered by eight firms. With gross weight of 2,400 lb., D 140 is designed for top speed of 360 mph, cruise speed of 140 mph and stall speed 60 mph. Production plans call for shipment of 36 planes monthly after flight tests are completed.

Away's two civilian-operated primary flight schools in North U.S. Army Air base will have trained more than 2,000 pilots in fixed wing and rotary aircraft. Camp Gan, San Marcos, Tex., which has opened nearly two years without a serious accident operation, were 236 Cessna 172B and 236, and a Mustang more than 6,000 (fixed wing) aircraft primary helicopter.

YOUR FUTURE IS GREAT IN A GROWING AMERICA



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- More people** ... Four million babies yearly. U.S. population has doubled in just 30 years! And our priority needs have always followed our population curve.
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- More income** ... Family income after taxes is at an all-time high of \$1400—is expected to pass \$2000 by 1975.

- More production** ... U.S. production doubles every 10 years. We will require millions more people to make, sell and distribute our products.
- More savings** ... Individual savings are at highest level ever—\$10 billion a month income available for spending.
- More research** ... 600 billion spent each year will pay off in more jobs, better living, whole new industries.
- More needs** ... In the next few years we will need 2500 billion more of schools, highways, homes, durable equipment. Meeting these needs will create new opportunities for everyone.

Add them up and you have the makings of another big swing. Want planners, builders and buyers with ask him to get ready for it.

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(This space contributed as a public service by this magazine.)



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various configurations are available for rapid delivery to
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NOW, FOR THE FIRST TIME, Solar's portable Jupiter starting and servicing units are available for all-the-shell delivery! The dependable gas turbine units are used to provide large volumes of compressed air to start today's high-thrust jet engines — as well as their power for other important ground support applications. Compact and lightweight, the units can be mounted on self-propelled vehicles, small trucks and carts, and even on small boats to service advanced jet airplanes. Besides reliability, compactness and low weight, the economical Jupiter-powered units are easy to maintain, start instantly under severe temperature extremes and can be operated on almost any available fuel. For more information, write to Dept. F-55, Solar Aircraft Company, San Diego 12, California.

SOLAR
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SAN DIEGO
6125 HOBBS

school, Camp Walter, Musical Wells, Tex., has approximately 175 B-1B B-25 Raven options.

Executive aircraft equipment is owned by Chambliss Aviation, Inc., Alton, Ill., Memphis Airport, includes several jet in final development stages for Beech Twin Mustangs, RCA AV-9B installation, new Lockheed radars for use with lightweight equipment, modified Fiberglass one piece air star door for Beech 19C.

Western Aircraft Corp., Spokane, Wash., has been licensed by Canadian Air Transport Board to operate charter services with aircraft of less than 1,250 lb payload to points in British Columbia, Alberta and Saskatchewan. In tentative agreement, Inc. St. Louis, Mo., has also been approved by the Board to handle charter services with aircraft of less than 5,000 lb payload in Ontario and Saskatchewan.

New distributor for Champion Aircraft and Monarch Aircraft in Blackfield Area Industries, Oakland, Calif., which formerly handled a Piper dealership. Farn will handle Champion line in California, Oregon, Washington and Hawaii, the Monarch line in Northern California.

STOL Aircraft landing area has been set up at Teterboro (N.Y.) Airport by Port of New York Authority covering 120 ft x 400 ft area to evaluate effect of runway of the runway status and possibility of providing similar steps at other airports.

Beech Travel Air production is now 11 a day and 100 of the new light twins have been delivered.

Auster Aircraft, Ltd., sold 15 available elementary business to the French government.

Winrock Corp. opened a jet and piston engine overhaul shop at 1748 North West 96th Ave., Miami, Fla. New Southwestern Division is managed by John Clark.

Year Heliprep Design Guide gives basic specifications and other data for building helipads for aircraft, industrial or charter use covering various sizes, wing configurations, elevated and ground level platforms. For copies write Helicopter Council, Aircraft Industries Assn. of America, Inc., 610 Shofar Building, Washington 3, D.C.

Flying Physicians Assn. now numbers 1,100 members, organization expects to have enrollment of 2,000 by its second meeting.

Engineers: work in dynamic science

North American's Columbus Division, home of the TBM jet trainer, F4-A Fury Jet and A-1J attack weapon system, is rapidly expanding its Dynamic Science Section. New aircraft, missiles, and research contracts have created excellent career opportunities in these fields:

AERODYNAMICS: Work entails make comprehensive studies on analytical factors and efficiency, evaluation of preliminary designs to determine from an aerodynamic standpoint the effects of structural flexibility on aero load distribution.

DYNAMIC TESTING: You'll be engaged in testing models in laboratory and wind tunnels, determining the effects of ground and flight vibration on complete systems, and measuring flight vibration in reproduced environments.

DYNAMIC ANALYSIS: Perform studies on the effect of gust, blast, and carrier operations on the structural system transient load. Apply a generalized harmonic analysis to random vibrations on rigid bodies. Ascertain the effects of flexibility on structural response characteristics.

ANALOG COMPUTING: Work on the development of analog techniques, circuits, methods... conduct experimental operations by applying differential analysis techniques.

Applicants with at least one degree and related industrial experience are invited to write or apply to:

Engineering Personnel
North American Aviation, Inc.
4990 East Fifth Avenue
Columbus, Ohio

THE COLUMBUS DIVISION OF
NORTH AMERICAN AVIATION, INC.





STRAIGHT TALK TO ENGINEERS

from Donald W. Douglas, Jr.

President, Douglas Aircraft Co., Inc.

Here at Douglas we're involved in a greatly accelerated missile and space program. This requires one of the most intensive engineering and research efforts in our history.

The problems are great ones as we move into the new dimension of unarmored and manned space vehicles. They require specialists in almost every engineering field. But their solution will

result in great benefits not only to our own nation but to all mankind.

If you're interested in tackling these problems with us... in giving your best in an all-out drive to solve them... we're interested in you!

Please write to Mr. C. C. La Vee
Douglas Aircraft Company, Box 630-M
Santa Monica, California

WHO'S WHERE

(Continued from page 17)

Changes

Neil Burges, manager, newly established Commercial Engine Operation, General Vertices Aircraft Gas Turbine Division, Cincinnati, Ohio.

Wilbur B. St. John, sales manager for advance aircraft-engineering aircraft engine (Machete, Kan.), General Division, East Inc., Santa Monica, Calif.

Samuel S. Allinson, Western regional manager (Los Angeles, Calif.), Aero-Aero, sales engineering division of Cleveland Aircraft Industries, Inc., Cleveland, Ohio.

Jose H. Kabanek, assistant manager for sales and distribution, Phoenix Aircraft Division, Boeing Aerospace Co., Seattle, Wash.

Roger B. Robinson, chief engineer, Ball Industries Co., Inc., Fort Worth, Tex.

Elbert McMichael, chief engineer, Commercial Division, Tapp Manufacturing Co., Los Angeles, Calif.

Walter K. Benson, chief engineer for new products, Aero Industries Division, Vicksburg, Inc., Detroit, Mich.

Frank Kuchner, engineering coordinator, major projects, the Auto Co., Cleveland, Ohio.

Robert Bennett, assistant director operations engineering department and assistant chief engineering, McCormick Selph Associates, Inc., Elkhart, Ind.

Alvin J. Edwards, general manager, Dayton Electronics Division, Mid Continent Manufacturing, Inc., Mableton, Ga.

Francis Bendis, general manager, LSCA, Dallas.

Frank Schuster, foreign sales representative, Lockheed Aircraft Service, Inc., New York, N.Y.

John E. Down, chief engineer, Frank E. Cook Co., Denver, Colo.

Gordon F. Wygant, sales manager, General Aero Products, Inc., Cuyahoga, Ohio.

Dr. S. M. Martin, Jr., general manager, newly formed Chemical Division, Thermochemical Corp., Trenton, N.J.

Felix, sales manager, F. W. Wilson products, New York, N.Y.

Edward F. Lefter, technical sales representative, Motion Chemical Division of Best Western Corp., Glen, Ind.

Maude E. Marks, chief engineer, Ohio Laboratories, Inc., Pasadena, Calif.

Donald E. Quisenberry, sales manager, Joseph J. McLaughlin, assistant research manager, Taylor Ede Co., Norwalk, Conn.

Howard C. Ross, general manager, Tapp Engineering Division, Inc., Santa Monica, Calif.

Thomas F. D'Andrea, technical sales manager, Components Division, Fairchild Controls Corp., Elmhurst, N.Y.

Col. Robert M. Bennett (USA, ret.), plant engineering coordinator and assistant to the president, Fluor Corp., Maywood, Ill.



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- COMMUNICATIONS:** radio, digital, data links
- NAVIGATION:** radio, inertial, ground-controlled
- COMBAT/REPAIRS:** ECM, electronic warfare
- OPERATIONS ANALYSIS**

For an interview, write Dept. A216 or call NCNemedy 5-6111

Bendix Systems Division

ANN ARBOR, MICHIGAN



dedication *Frederick* welcomes the opinions of its readers on the issues raised in the newsletter's editorial columns. Address letters to the Editor, *Frederick* Periodic, 35 W. 42 St., New York 36, N. Y. To keep letters under 500 words and to keep a genuine identification. We will print anonymous letters, but names cannot be withheld on request.

This is in reference to our report "The
 Fall Between Two G Force Effects" on
 p. 35 of the May 12 issue of *American*
Physicist.

That idea was a result of studies conducted on free-living, working adolescents in terms of 100Gs for periods of 6 to 8 hours at a time or less in fact. These are on second shift: people have no school—no life support—starts up to 100Gs in a rapid position without the benefit of basal intensity.

4. What are the current
 Director
 Aviation Crash Injury Research
 Site Under Report
 Phoenix, Arizona

Cheng, Jeffrey J., and Suzanne M. Morse.

Other agreements will follow. The S&P will begin talks with the U.S. on a bilateral agreement. Can the U.S. avoid firm or ISO standards as the use of the English language in an audio language? Even if the Soviets agree to the use of the English language, would it be used in such a way that misunderstanding between the speakers even, and the ground even, is impossible? It has a forward can be created in case of communication?

On the other hand if the State is to assist upon the use of the Russian language in Russian frontier, should the cries of the natives, here "No Russian language" No Other country could follow the example of Russia in regarding the use of their own language over their frontier. This would be the solution of communication in the interior and of traffic. There is a control and we are discussing solution for international communication which possibly give rights we could opportunities for all parties it is the international language Esperanto. This is better in understanding the word universal use. It is a matter of fact that Esperanto can be mastered in a brief course of a

Deviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, *Deviation Week*, 450 W. 42 St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

one it tries to learn other languages. Its motto is: "We are people of the language." Each speech is the golden thread connecting it to the vibrant earth that nurtures it.

President Eisenhower and many other leading Americans have captured the importance of people to people contact in many international undertakings. The international air traffic is now the main artery around which many foreign people to gather it is the bridge from countries to countries with a span that runs the world. This bridge brings people together but not philosophies. The other bridge which brings the people together spiritually is the sister culture of language. Foremost

Now is the time to introduce Esperanto into the international air traffic. There is a field where an international language is urgently needed. It is a need from the environmental point of view. Electronic computers can't do the job. The communication must go from person to person on a neutral basis of a common language.

I've got to take some with Mr. H. F. Sasser (WW No. 1, p. 151) who seems to be the Lone Wolf type of attempted whitehead in the KKK's Island tragedy.

It is possible that it is because a chair, he must have been having a little trouble with the proper procedure the necessary from a small or the

I'm not deflating Cape Mank's tech image, but words must be said so that a cringing or nodding acquiescence adequate to get you out of a stuffy restaurant here will still prevail. I love and like the rate of clinical advancement showing a constant and steady climb will obviously keep the assistant from coming down (which it did).

Something went wrong in that airplane either with the instruments or the pilot. Responsible people have expressed their confidence and openness which differs depending on viewpoint.

Robert C. Cialdini
474.48439
Berkeley, Calif.

Having now read the two related articles on the protection of the Sahel (13 March 24 p. 46 and March 31, p. 64), I have discovered a slight oversight in a caption. When it is stated that the presence of our Airframe within pass is 4000 ft. It should of course, be 5000 feet. Naturally, most people reading that article will understand that it is just a misprint. But, if it is

Hiro C. Anagnostou
Berkeley, California, USA
Berkeley, CA, USA

In M.P.A. Council 16 The American for a captain the additional pilot crew country

APPELLATION	RIB	STATUS
1st Officer	Copilot	Pilot
2nd Officer	Navigator	Pilot
3rd Officer	Pilot (Junior)	Pilot

When you visit the Junior Pilot 3rd Officer as an eligible member a safe ball run.

Of one thing you may be certain throughout—LPT is able to operate the copilot if they are active with their wingmen onto

Curry Jones C O'Connor
Newark, Conn.

The March 10 case at Vassar, New York (p. 45) repeats the results from another infestation of a Comor 3 nestage bonded with 12 as spread loops which added a 3P⁺ and some reduction in this area. For the reduction the large weighed at least one half as much as the also if both were connected from the same antenna.

100°; further, the 100°-120° range is a 10°-20° further rise. Such a comparison would help to establish the relative merits of long- and short-run approaches to the reduction of acid rainfalls.

Robert J. Muenster
Tech. Sergeant
Weight Air Development Center
Denton, Ohio



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Elastic stop nuts... *make first trip to the exosphere*

What were the requirements for an exploratory trip into the exosphere? The success of project Far Side established these two among others:

1. A launching platform located as far as possible above the effects of atmospheric drag
2. The use of hardware of proved ability

Some of this hardware can be seen in the close-up of Far Side's nose-mounted payload. In the photo showing the payload before the nose cone was placed over it, three of the four Elastic Stop nuts used to secure the third stage rockets to a retaining ring are clearly visible. They are standard ESNA hex nuts—with the familiar red nylon insert. These are the self-locking fasteners that have proved their ability to hold tight under the severest requirements of aircraft operation, through almost three decades of progress in aircraft design and construction. And now they have proved their ability to meet the requirements and unusual environment of space travel.



The complete line offered by ESNA includes self-locking nut designs for every missile, aircraft and power plant application. They cover a range of operating temperature requirements from -80°F . to over 1300°F . For specific information, send the details of your application to ESNA. Write to Dept. S17-625, Elastic Stop Nut Corporation of America, 2330 Vauxhall Road, Union, New Jersey.



**ELASTIC STOP NUT
CORPORATION OF AMERICA**

An artist's version of the launching of the Far Side rocket. The four-stage vehicle was carried to an altitude of 100,000 feet by a polyethylene balloon made by General Mills. Fired straight up through the balloon, Far Side rocketed to the greatest distance from the earth ever reached by a man-made device. The prime contractor for the Far Side project was Aeronautic Systems, Inc., a subsidiary of the Ford Motor Company, for the Air Force Office of Scientific Research (ARDC).